COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

IN THE MATTER OF:	:	
	:	
City of Pittsburgh	:	Clean Streams Law
and	:	Sewerage
Pittsburgh Water and Sewer Authority	:	
Allegheny County	:	
	:	

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Exhibit A — Correspondence from Charles A. Duritsa, Department of Environmental Protection, to Clifford B. Levine and Jacqueline Morrow, dated April 21, 2004

Exhibit B — Consent Order and Agreement

Exhibit C — Correspondence from Clifford B. Levine and Jacqueline Morrow to Bruce M. Herschlag, Department of Environmental Protection, dated April 21, 2004

Pennsylvania Department of Environmental Protection

400 Waterfront Drive
Pittsburgh, PA 15222-4745

April 21, 2004

Southwest Regional Office 412-442-4000

Clifford B. Levine, Esquire
Thorp, Reed & Armstrong, LLP
One Oxford Centre
301 Grant Street
Pittsburgh, PA 15219-1425

Jacqueline Morrow, Esquire
City County Building, Suite 313
414 Grant Street
Pittsburgh, PA 15219

RE: In re Pittsburgh Water and Sewer Authority ("PWSA") and City of Pittsburgh ("City") Consent Order and Agreement

Dear Mr. Levine and Ms. Morrow:

Please find enclosed for each of your files an original counterpart of the above-referenced Consent Order and Agreement. The Department appreciates the PWSA and the City committing to assess their sewer system as part of a solution to the region's sewer system problems. For the duration of the Consent Order and Agreement, the Department will consider compliance with this Consent Order and Agreement compliance with the Clean Streams Law for the alleged violations set forth in Paragraphs M through S of the Consent Order and Agreement. In addition, provided PWSA and the City remain in compliance with the provisions of the Consent Order and Agreement, the Department will not initiate any enforcement action against PWSA and the City or any of their officers, officials, agents or employees, for the past violations alleged in Paragraphs T through U of the Consent Order and Agreement.

Several municipalities have inquired about their relationship with ALCOSAN during the implementation of this Consent Order and Agreement. Please be advised that the United States Environmental Protection Agency is negotiating a Consent Decree with ALCOSAN that will, *inter alia*, require ALCOSAN to cooperate with municipalities in the activities covered by this Consent Order and Agreement in which the municipalities are required to cooperate with ALCOSAN.

APR 22 2004

If you ever have any questions concerning any requirement of the Consent Order and Agreement, please fell free to have your technical representatives contact Paul Eiswerth of our Water Management program at 412-442-4055 or you can contact Assistant Counsel Bruce M. Herschlag of our legal staff at 412-442-4262.

Thank you for your cooperation in this matter.

Sincerely,

Charles A. Duritsa
Regional Director

Enclosure

BMH:thh

cc: Gregory F. Tutsock (w/ encl.)
Michael Lichte (w/o encl.)
Guy Costa (w/ encl.)
David McGuigan (w/o encls.)
Kerry Nelson, Esquire (w/o encls.)
Angela McFadden (w/ encls.)
Matthew Morrison, Esquire (w/o encls.)
Geoff Butia, ACHD (w/ encls.)
Bruce M. Herschlag, Esquire (w/ encls.)

(Levine_Morrow01_Ltr)

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

IN THE MATTER OF:

City of Pittsburgh	:	Clean Streams Law
and	:	Sewerage
Pittsburgh Water and Sewer	:	
Authority	:	
Allegheny County	:	

CONSENT ORDER AND AGREEMENT

This Consent Order and Agreement ("COA") is entered into this 29th day of JANUARY, 2004, by and between the Commonwealth of Pennsylvania, Department of Environmental Protection ("Department"), the Allegheny County Health Department ("ACHD"), the City of Pittsburgh ("Municipality") and the Pittsburgh Water and Sewer Authority ("Authority").

The Department has found and determined the following:

A. The Department is the agency with the duty and authority to administer and enforce The Clean Streams Law, Act of June 22, 1937, P.L. 1987, *as amended*, 35 P.S. §§ 691.1-691-1001 ("Clean Streams Law"); Section 1917-A of the Administrative Code of 1929, Act of April 9, 1929, P.L. 177, *as amended*, 71 P.S. § 510-17 ("Administrative Code"), and the rules and regulations ("rules and regulations") promulgated thereunder.

B. The ACHD is a health department organized under the Local Health Administration Law, Act 315 of August 24, 1951, P.L. 1304, *as amended*, P.S. §§ 12001 *et seq*., and executes powers and duties vested in it by laws of the Commonwealth, and the rules and regulations of the State Department of Health and other departments, boards, or commissions of the State government.

C. The Municipality is a municipality as defined in Section 1 of the Clean Streams Law, 35 P.S. § 691.1, with a mailing address of 301 City-County Building, 414 Grant Street, Pittsburgh, Pennsylvania 15219.

D. The Authority is a municipal authority formed pursuant to the Authorities Act, the Act of May 2, 1945, P.L. No. 164, *as amended*, 53 P.S. §§ 301 *et seq*., with a mailing address of 441 Smithfield Street, Pittsburgh, Pennsylvania 15222. The Authority is also a municipality as defined in Section 1 of the Clean Streams Law, 35 P.S. § 691.1.

E. For the purpose of this COA, a combined sewer system ("CSS") shall mean the Municipality's public sewer system or parts thereof which was designed, permitted, built and operated to carry sanitary sewage, storm water and industrial waste. For purposes of this COA, the term CSS or "combined sewer system" includes wildcat sewers and common sewers not privately owned but shall not include private laterals and privately owned common sewers.

F. A combined sewer overflow ("CSO") is a wet weather overflow discharge from a CSS occurring before the headworks of the Woods Run Sewage Treatment Plant ("Woods Run STP"). As used in this COA, the term CSO may also be used to refer to a point within the CSS at a location prior to the headworks of the Woods Run STP, at which materials are discharged from the combined sewer systems.

G. The Municipality and the Authority own or operate a CSS with CSOs in the City of Pittsburgh, Allegheny County. The CSOs discharge to waters of the Commonwealth including, but not limited to, the Monongahela River, the Allegheny River, the Ohio River and their tributaries. The CSOs constitute sewage under Section 1 of the Clean Streams Law, 35 Pa. Code § 691.1.

H. The CSO(s) from the CSS of the Municipality and/or the Authority will be listed in, and authorized by, an Individual National Pollutant Discharge Elimination System Permit PA0217611 ("NPDES Permit") issued by the Department to the Municipality and the Authority, pursuant to Sections 201 and 202 of the Clean Streams Law, 35 Pa. Code §§ 691.201 and 691.202. The NPDES Permit will be issued simultaneously with the execution of this Consent Order and Agreement.

I. The City of Pittsburgh is upstream of and contributes to CSOs from sewer systems owned or operated by another municipality or municipal authority including the Allegheny County Sanitary Authority ("ALCOSAN").

J. Portions of the sewer system which the Municipality and the Authority own and operate are a separate sanitary sewer system ("SSS" or "sanitary sewer system") which was designed, permitted and built to carry sanitary sewage and industrial waste. For the purposes of this COA, any reference to the term "SSS" or "sanitary sewer system" includes wildcat sewers and common sewers not privately owned but shall not include private laterals or privately owned common sewers.

K. A Sanitary Sewer Overflow (hereinafter "SSO") is an unauthorized discharge of untreated sewage from a SSS. As used in this Consent Order and

Agreement, the term SSO may also be used to refer to a point within the SSS or a downgradient SSS, at a location prior to the Woods Run STP, at which a discharge occurs from an SSS.

L. The Municipality and the Authority ultimately convey sewage flows to the Woods Run STP which is owned and operated by ALCOSAN. ALCOSAN has a NPDES Permit to discharge treated sewage under certain conditions from the Woods Run STP.

CSO Issues

M. Under Section 402(q) of the Clean Water Act, 33 U.S.C. § 1342(q), the Municipality, the Authority and ALCOSAN must comply with the Combined Sewer Overflow Control Policy signed by the Environmental Protection Agency Administrator on April 11, 1994 ("CSO Control Policy").

N. The CSO Control Policy represents a comprehensive national strategy to ensure that municipalities and the public engage in a comprehensive and coordinated planning effort to achieve CSO controls that ultimately meet appropriate health and environmental objectives.

O. The Municipality and the Authority, pursuant to the CSO Control Policy and its NPDES Permit will be required to evaluate their CSSs and CSOs.

P. Pursuant to Part C of the NPDES Permit, the Municipality and the Authority are required to submit to the Department a Long Term CSO Control Plan ("LTCP") within 48 months after the effective date of the NPDES Permit.

Q. To develop a LTCP, a municipality must, in part, rely on a System Inventory Characterization, a System Hydraulic Characterization and the Documentation of Implementation of the Nine Minimum Controls ("NMCs").

R. The CSO Control Policy requires all municipalities, such as the Municipality and the Authority, tributary to a CSO to cooperate with the development and implementation of a LTCP.

S. Development and implementation of a LTCP is a comprehensive process which will require coordination with other municipalities and with ALCOSAN.

SSO Issues

T. The Department alleges that the Municipality and the Authority periodically:

1. discharge untreated sewage from one or more SSOs in its sanitary sewer system;

2. contribute to the discharge of untreated sewage from one or more SSOs in municipal sanitary sewer systems downgradient from the City of Pittsburgh; and/or

3. contribute to the discharge of untreated sewage from one or more SSOs at the point of connection to the ALCOSAN Sewer System.

U. The Department alleges that the Municipality's and the Authority's actions described in Paragraph T above are not authorized and constitute violations of Sections 201 and 202 of the Clean Streams Law, 35 P.S. §§ 691.201 and 691.202; constitute statutory nuisances pursuant to Section 202 of the Clean Streams Law, 35 P.S. § 601.202;

and constitutes unlawful conduct pursuant to Section 611 of the Clean Streams Law, 35 P.S. § 691.611.

Operation and Maintenance

V. The Department issued to the Municipality Water Quality Management Permits which require the Municipality, *inter alia*, to properly operate and maintain its CSS, CSOs and SSS.

W. Also, pursuant to the NPDES Permit, the Municipality and the Authority are required to properly operate and maintain their CSS and CSOs.

X. Section 203 of the Clean Streams Law, 35 P.S. § 691.203, requires, *inter alia*, municipalities to file reports with the Department to enable the Department to determine whether existing sewer systems are adequate to meet present and future needs.

Y. In addition, Section 203 of the Clean Streams Law, 35 P.S. § 691.203, requires municipalities to construct, complete, extend and operate treatment facilities necessary to properly provide for the prevention of pollution or prevention of a public health nuisance and to negotiate with other municipalities for combined or joint sewer systems and treatment facilities.

Z. Section 210 of the Clean Streams Law, 35 P.S. § 691.210, requires a municipality to diligently comply with any Order issued pursuant to Section 203 of the Clean Streams Law.

After full and complete negotiation of all matters set forth in this Consent Order and Agreement and upon mutual exchange of covenants contained herein, the parties desiring to avoid litigation and intending to be legally bound, it is hereby ORDERED by the Department and AGREED to by the Municipality as follows:

1. **Authority.** This Consent Order and Agreement is an Order of the Department authorized and issued pursuant to Sections 5, 203, 316, 402 and 610 of the Clean Streams Law, 35 P.S. §§ 691.5, 691.203, 691.316, 691.402 and 691.610 and Section 1917-A of the Administrative Code, *supra*.

2. **Findings.**

a. The Municipality and the Authority agree that the findings in Paragraphs A through S and V through Z are true and correct and, in any matter or proceeding involving the Municipality and/or the Authority and the Department, the Municipality and the Authority shall not challenge the accuracy or validity of these findings

b. The parties do not authorize any other persons to use the findings in this Consent Order and Agreement in any matter or proceeding.

Phase I - System Inventory and Characterization/Basic Operation and Maintenance

3. **Retention of Engineer**. As to all tasks set forth in Paragraphs 4 through 11 below, the Municipality and the Authority shall employ the services of a Professional Engineer to be knowledgeable of the status of such tasks and to maintain an appropriate level of oversight regarding the completion of all such tasks.

4. **Physical Survey/Visual Inspection.**

a. "Critical Sewers" within the Municipality's and Authority's combined sewer system shall be defined based on accepted engineering principles and shall include:

(i) trunk sewers that are a final conveyance to the ALCOSAN Sewer System;

(ii) sewers associated with areas of chronic basement flooding as known by the Municipality's or Authority's employees, agents, contractors or reported by the Department or ACHD;

(iii) sewers associated with areas of chronic maintenance as known by the Municipality's or Authority's officers, employees, agents or contractors;

(iv) sewers associated with areas of chronic surcharge unless said surcharge is intentionally induced in accordance with the NMC requirements;

(v) sewers downstream of flow diversion structures;

(vi) sewers where additional information is necessary for model development; and

vii) sewers deemed a priority for inspection by a professional engineer.

b. "Non-Critical Sewers" shall be defined as any portion of the Municipality's and Authority's combined sewer system not defined as "Critical Sewers" pursuant to Paragraph 4.a above.

c. By May 31, 2007, the Municipality and the Authority shall complete a physical survey/visual inspection of the Critical Sewers and of their sanitary sewer system, excepting any portion of the sewer systems constructed or reconstructed since January 1, 1995 with records of post-construction municipal inspection consistent with the requirements of this Paragraph 4.

d. By May 31, 2014, the Municipality and the Authority shall complete a physical survey/visual inspection of the Non-Critical Sewers, excepting any portion of the combined sewer system constructed or reconstructed since January 1, 1995 with records of post-construction municipality inspection consistent with the requirements of this Paragraph 4.

e. All physical surveys/visual inspections required by this Paragraph 4 shall include all accessible manholes, exposed sewer lines and other visible sewer appurtenances, including but not limited to, features within the sanitary sewer system intended to release excess flow during wet weather events ("SSO Structures"), siphon chambers, pump stations, exposed force mains, combined sewer regulators, diversion chambers, and accessible outfall pipes and structures. The physical surveys/visual inspections shall identify defects related to safety, defects related to structural stability, accumulated sediment and debris deposits, visible flow bottlenecks, evidence of present or prior surcharging (excepting areas where surcharging has been intentionally induced in accordance with NMC requirements) or overflows, the location of all SSO Structures, and any other condition that compromises or diminishes the hydraulic capacity of the combined sewer system or the sanitary sewer system. The physical surveys/visual inspections shall also identify defects including the conveyance of streams, receiving stream back flow, and defects in the sanitary sewer system that allow the entrance of infiltration and inflow that compromise and/or diminish the hydraulic capacity of the sanitary sewer system. Physical surveys/visual inspections shall be performed for all accessible manholes, both interior and exposed exterior, and of each sewer line connection at such manholes. The physical surveys/visual inspections shall note all documented manholes that cannot be located, visually or with metal detectors, and areas where additional manholes need to be constructed.

f. The Municipality and the Authority shall be given credit for past physical survey/visual inspection work if it has been completed since January 1, 1998 and the Municipality and/or the Authority can demonstrate through documentation that said work meets the requirements of Paragraph 4.

5. **<u>Sewer Line Cleaning and Closed Circuit Television (CCTV) Internal Inspection</u>.**

a. By May 31, 2010, the Municipality and the Authority shall complete a CCTV internal inspection of the Critical Sewers and the entire separate sanitary sewer system, excepting any portion of the system constructed or reconstructed since January 1, 1995 with records of post-construction municipal inspection consistent with the requirements of Paragraph 5.e. The Municipality and the Authority shall perform sewer line cleaning to support CCTV inspection to the extent possible via conventional sewer cleaning techniques to allow an internal inspection by CCTV to detect structural defects, misalignment, infiltration sources and root intrusions.

b. By November 30, 2006, the Municipality and the Authority shall inspect by CCTV the sewers in their sanitary sewer system that:

(i) are trunk sewer segments which are a final conveyance to the ALCOSAN Sewer System;

(ii) are 10 inches in diameter or greater;

(iii) are associated with areas of chronic basement flooding, chronic maintenance and chronic surcharge areas;

(iv) are upstream and downstream of SSOs;

(v) require additional information suitable for model development purposes; and/or

(vi) are deemed necessary by a Professional Engineer for such inspection.

c. By June 30, 2012, the Municipality and the Authority shall complete CCTV Internal Inspection of Non-Critical Sewers in accordance with the requirements of Paragraphs 5 and 13 of this Consent Order and Agreement. The Municipality and the Authority shall perform sewer line cleaning to support CCTV inspection to the extent possible via conventional sewer cleaning techniques to allow an internal inspection by CCTV to detect structural defects, misalignment, infiltration sources and root intrusions.

d. As a result of CCTV inspection the Municipality and the Authority shall record:

(i) all defects that allow the entrance of infiltration to their combined sewers;

(ii) all defects that allow the entrance of infiltration and inflow to their sanitary sewer lines;

(iii) all structural defects;

(iv) all defects that compromise or diminish the carrying capacity of the combined sewer lines and the sanitary sewer lines;

(v) all defects in siphons; combined regulator structures, diversion chambers and accessible outfall pipes and structures; and

(vi) conditions and/or modifications of the sanitary sewer system that allow for SSOs.

This CCTV record shall also include audio/video documentation with a written summary to include, but not be limited to, the location of roots, defective joints, defective pipes, sewer line depressions, break-in lateral connections, grease accumulations and sediment accumulations. Additionally, this CCTV record shall include a location reference, incorporate a defect code and defined level of severity or grade associated with each condition noted in the inspection report. These codes and grades shall utilize a uniform ranking and rating system, for example NASSCO.

e. Data from previous sewer line CCTV inspections conducted between January 1, 1993 and December 31, 1999 may be used to meet the requirements of Paragraph 5, if the following conditions are met:

(i) the inspection indicated that the sewer had no defects causing a restriction in flow or conditions allowing excessive infiltration into the combined sewer system, or excessive infiltration and inflow into the sanitary sewer system;

(ii) the inspection indicated that the sewer had no significant root intrusions;

(iii) the documentation for the inspection is readily available and includes a visual record of observations, a written summary and conclusions;

(iv) there are no basement backups along the sewer line segment (a "sewer line segment" is defined herein as a contiguous manhole-to-manhole section of sewer pipe); and

(v) the sewer line segment does not have chronic surcharges.

f. Supplemental CCTV inspection shall not be required for sewer line segments televised on or after January 1, 2000 that document conditions as stated in paragraph 5.d.

g. Previous CCTV inspection submitted to the Department for past work credit need not be transferred into a standard format.

6. **<u>Sewer System Mapping</u>.** By May 31, 2007, the Municipality and the Authority shall submit to the Department and to the ACHD an updated comprehensive sewer map of their sewer system, in accordance with the GIS Protocol set forth in Appendix A, which is attached and fully incorporated by reference. The Municipality and the Authority shall be given credit for previous sewer system mapping data if the data meets the requirements of Appendix A and is incorporated into the updated comprehensive sewer map as required in this Paragraph.

7. **<u>Sewer System Dye Testing and Enforcement.</u>**

a. By May 31, 2007, the Municipality and the Authority shall for their sanitary sewer system:

(i) complete dye testing or other testing methods (excluding the use of smoke testing to detect roof leaders) of all structures to determine the sources of surface stormwater such as roof leaders, yard drains, and driveway drains, excepting any portion of the sanitary sewer system constructed or reconstructed since January 1, 1995, with records of dye testing conducted in accordance with this Paragraph;

(ii) test all private and municipal catch basins within 100 feet of the sanitary sewer to verify that they are not connected to the sanitary sewer; and

(iii) document any illegal connections to the sanitary sewer system from structures or catch basins in the GIS map, a relational database consistent with the requirements in Paragraph 11 (Data Collection & Submission), or a digital spreadsheet such as Microsoft Excel.

b. Previous dye testing results, completed on or after January 1, 1985, of structures, and previous CCTV inspection, physical inspection, dye testing, and/or smoke testing of private and municipal catch basins, documenting negative findings (i.e., no illegal connection) may be used to satisfy the requirements of this Paragraph.

c. Previous dye test results completed on or after January 1, 1985, of structures, and previous CCTV inspection, physical inspection, dye testing, and/or smoke testing of private and municipal catch basins, documenting positive results (i.e., illegal connections) may be used to satisfy the requirements of Paragraph 7, if the illegal connections were removed and documented, or if the Municipality and/or Authority have initiated and are diligently prosecuting a legal or equitable action against the owner of the property in order to seek a resolution of the violation(s). Documentation of the corrections and/or legal actions shall be submitted to the Department and/or ACHD upon request.

d. By November 1, 2004, the Municipality and the Authority shall:

(i) institute and enforce an ordinance or regulation prohibiting connections of surface stormwater to their sanitary sewer system; and

(ii) institute and enforce a sewer use ordinance or regulation which requires at the time of all property sales within the City of Pittsburgh, a visual inspection and dye test of items referenced in this Paragraph to identify illegal connections. The ordinance or regulation shall require the removal of the illegal connections prior to the sale of the property.

e. (i) By November 30, 2007, the Municipality and the Authority shall require corrective actions to ensure the removal of 95% of the number of illegal connections of sources of surface stormwater identified in this Paragraph or be diligently prosecuting the responsible party(ies) in a legal or equitable action for the removal of said sources from their sanitary sewer system. Removal of such illegal connections to the sanitary sewer system from structures or catch basins shall be documented in the GIS map, a relational database consistent with the requirements of Paragraph 11, or a digital spreadsheet such as Microsoft Excel.

(ii) For the remaining 5% of illegal connections, if the Municipality and the Authority elect not to remove an illegal connection, they shall document the reasons for that decision. This documentation shall be submitted to the Department and ACHD.

8. **Sewer System Deficiency Corrections:**

a. By November 30, 2010, the Municipality and the Authority shall for their sanitary sewer system:

(i) complete the repair of all structurally deficient manholes that accept storm water and/or surface water inflow and all defective siphons, pump stations, and force mains identified during the Phase I Assessment tasks completed pursuant to Paragraphs 4 through 7; and

(ii) remove all streams and springs connected to the sewer lines as identified in Paragraphs 4 through 7.

b. By November 30, 2010, the Municipality and the Authority shall for the Critical Sewers:

(i) complete the repair of all structurally deficient manholes and all defective siphons, pump stations, force mains, combined sewer regulators, diversion chambers and all outfall pipes and structures identified pursuant to Paragraphs 4 and/or 5.d(v);

(ii) eliminate the conveyance of streams by the sewer system and receiving stream backflow into the sewer system, as appropriate, based on a cost-effectiveness analysis to be submitted for Department review and written approval; and

(iii) replace or repair all sewer lines identified during sewer line cleaning and internal inspection completed pursuant to Paragraphs 4 and 5 that restrict flows to the extent wet weather backups or overflows occur at locations other than permitted outfall structures.

c. As part of its NMCs, the Municipality and the Authority shall for the Non-Critical Sewers:

(i) complete the repair of all structurally deficient manholes and all defective siphons, pump stations, force mains, combined sewer regulators, diversion chambers and all outfall pipes and structures identified pursuant to Paragraphs 4 and 5.d(v);

(ii) eliminate the conveyance of streams by the sewer system and receiving stream backflow into the sewer system, as appropriate, based on a cost-effectiveness analysis to be submitted for Department review and written approval; and

(iii) replace or repair all sewer lines identified during sewer line cleaning and internal inspection completed pursuant to Paragraphs 4 and 5 and its NMCs that restrict flows to the extent wet weather backups or overflows occur at locations other than permitted outfall structures.

d. Within thirty (30) days of discovery, the Municipality and the Authority shall initiate repair of all significant structural defects identified pursuant to Paragraphs 4, 5, 7, and its NMCs, such as; sewer lines with collapsed section(s), section(s) with crown and/or invert missing, dirt pipe (missing pipe), void in backfill, complete sewage flow blockage, and any other defect that the overseeing Professional Engineer determines to need immediate attention and complete such repairs within six (6) months of discovery.

9. **<u>System Hydraulic Characterization</u>.**

a. By May 31, 2008, as part of its System Hydraulic Characterization, the Municipality and the Authority shall complete a hydraulic capacity evaluation of their sewer system, signed and sealed by a Professional Engineer utilizing accepted engineering methods that, at a minimum, includes a hydraulic capacity analysis of each sewer line listed in Paragraphs 5.a and 5.b and inclusive of siphons, force mains, pump stations, regulator chambers, diversion chambers and outfall sewers; their dry weather flow and their peak flow. This evaluation shall analyze the dry weather flow and hydraulic capacities, characterize the collection system's performance, provide data on the frequency, volume, and duration of combined sewer overflows on an annual basis and evaluate where opportunities exist for in-system storage and maximization of wet weather flows. Also, this evaluation may be performed simultaneously with the physical surveys/visual inspections, sewer line cleaning, and internal inspection requirements contained herein. This data shall be documented in accordance with the Sewer Data Dictionary referenced in Appendix A. The Municipality and the Authority shall submit to the Department and ACHD the information the Municipality and Authority develop for the Municipality's and the Authority's System Hydraulic Characterization in the following manner:

(i) information as to one-quarter of its sewer system by May 31, 2005;

(ii) information as to one-half of its sewer system by May 31, 2006;

(iii) information as to three-quarters of its sewer system by May 31, 2007; and

(iv) information as to all of its sewer system by May 31, 2008.

b. Previous System Hydraulic Characterization may be used to satisfy the requirements of this Paragraph if the following conditions are met:

(i) the evaluation verifies the current hydraulic conditions;

(ii) the evaluation was performed, and signed and sealed by a Professional Engineer utilizing accepted engineering methods; and

(iii) the results of the evaluation have the information necessary to characterize the hydraulic performance of the sewer system under various precipitation/wet weather conditions.

10. **Implementation Schedule.**

a. The Municipality and the Authority shall complete the actions required by Paragraph 4.c for at least one-third of their Critical Sewers and their sanitary sewers each twelve (12) months (i.e., one-third by May 31, 2005, two-thirds by May 31, 2006, and all by May 31, 2007); and shall complete the actions required by Paragraph 4.d for their Non-Critical Sewers as part of their NMCs (see Paragraph 13.a of this Consent Order and Agreement) by May 31, 2014.

b. The Municipality and the Authority shall complete the actions required by Paragraph 5.a for at least one-sixth of the Critical Sewers and one-sixth of their sanitary sewer system each twelve (12) months (i.e. one- sixth by May 31, 2005; one-third by May 31, 2006; one-half by May 31, 2007; two-thirds by May 31, 2008, five-sixths by May 31, 2009, and all by May 31, 2010) beginning with sewers referenced in Paragraph 5.b; and shall complete the actions required by Paragraph 5.c for their Non-Critical Sewers as part of their NMCs (see Paragraph 13 of this Consent Order and Agreement).

c. The Municipality and the Authority shall complete the actions required by Paragraph 5.b by November 30, 2006.

d. The Municipality and the Authority shall complete the actions required by Paragraph 6 for at least one-third of their sewer system and shall complete the actions required by Paragraph 7 for at least one-third of their sanitary sewer system each twelve (12) months. (i.e. one-third by May 31, 2005, two-thirds by May 31, 2006 and all by May 31, 2007.)

e. The Municipality and the Authority shall complete the actions required by Paragraphs 8.a and 8.b for at least one-fifth of the Critical Sewers and at least one-fifth of their sanitary sewer system each twelve (12) months starting in the second year of the Phase I System Inventory and Characterization (i.e. one-fifth by November 30, 2006; two-fifths by November 30, 2007; three-fifths by November 30, 2008; four-fifths by November 30, 2009; and all by November 30, 2010); and shall complete the actions required by Paragraph 8.c for their Non-Critical Sewers as part of their NMCs (see Paragraph 13 of this Consent Order and Agreement).

f. The Municipality and the Authority shall complete the actions required by Paragraph 9 for at least one-fourth of its combined sewer system each twelve (12) months (i.e. one-fourth by May 31, 2005; one-half by May 31, 2006; three-quarters by May 31, 2007; and all by May 31, 2008).

11. **Data Collection and Submission.** All data collected under the Phase I tasks shall be retained and shall be made available for submission upon request by the Department and/or the ACHD within fifteen (15) days after the end of each calendar quarter to the Department and/or the ACHD at their respective addresses listed in Paragraph 30. GIS data shall be stored and shall be submitted to the Department and/or

the ACHD upon request in Environmental Systems Research Institute (ESRI)-compatible format, as specified in Paragraph 6. The CCTV data collected under Paragraph 5 shall be stored in digital format and shall be submitted to the Department and/or the ACHD upon request. All other data collected under Phase I tasks shall be formatted and stored in a relational database (Open Database Configuration compliant), such as Microsoft Access, Microsoft Excel or equivalent, and submitted to the Department and/or the ACHD upon request in a form equivalent to the example attached hereto as Appendix B. Flows shall be calculated and reported in million gallons per day (MGD), not cubic feet per second (CFS). Data shall be formatted to three (3) decimal places (x.xxx).

Phase II - Long Term Control Plan, Flow Monitoring and Planning

12. **Retention of Professional Engineer.** The Municipality and the Authority shall employ the services of a Professional Engineer to oversee the completion of all Phase II flow monitoring and planning tasks set forth in Paragraphs 13 through 16. All reports and submissions associated with the Phase II flow monitoring and planning tasks set forth in Paragraphs 13 through 16 shall be signed and sealed by the Professional Engineer.

13. **NMC.**

a. On or before December 1, 2005, the Municipality and Authority shall submit to the Department for its review and approval, and to the ACHD for its review and comment, appropriate documentation as set forth in Appendix C, demonstrating on a system-wide basis implementation of and compliance with the nine minimum technology-based controls ("NMC") listed in the CSO Control Policy.

Appendix C, which is attached hereto and incorporated fully by reference, lists the actions that, at a minimum, shall be included in the NMC Report. As part of their on-going obligation to implement the NMCs, the Municipality and the Authority shall, in an Operation and Maintenance Plan, address appropriate items, including but not limited to, the (1) physical inspection/visual survey of the Non-Critical Sewers, (2) CCTV internal inspection of Non-Critical Sewers and (3) the actions and repairs required by Paragraph 8.c. From June 1, 2010 through May 31, 2012, the Municipality and Authority shall, at a minimum, perform CCTV internal inspection of Non-Critical Sewers at an annual average rate equal to the annual average rate of the total number of miles of Critical Sewers and Sanitary Sewers the Municipality and Authority were required to televise under this Consent Order and Agreement between June 1, 2004 through May 31, 2010. In calculating the number of miles to be inspected from June 1, 2010 through May 31, 2012, the Municipality and Authority shall receive credit for any Non-Critical Sewers so inspected during the period from June 1, 2004 through May 31, 2010.

b. On December 1, 2010, the Municipality and the Authority shall submit to the Department, for its review and approval, and to the ACHD for its review and comment, an updated Operation and Maintenance Plan for those Non-Critical Sewers not addressed in Paragraph 13.a. and coordinating the Operation and Maintenance tasks with capital improvements and long term planning.

c. In implementing the NMCs, the Municipality shall conduct street sweeping on a regularly scheduled basis; establish and enforce municipal sewer use ordinances (especially with regard to oil and grease controls) and litter and refuse disposal measures; place and maintain trash receptacles to minimize street litter in areas where the public congregates; enforce pre-treatment requirements and adopt ordinances as necessary to ensure compliance with ALCOSAN's industrial pre-treatment requirements; cooperate with ALCOSAN to begin and maintain a program of public recycling; water conservation; the proper disposal of wastes and the proper application of fertilizer; institute periodic evaluations of programs to assure their efficacy and maintain documentation of all municipal NMC activities on an on-going basis.

14. **Flow Monitoring.**

a. On June 1, 2007, the Municipality and the Authority shall begin a program of flow monitoring of its sewer system to determine the average dry and peak wet weather flows conveyed directly or indirectly from the Municipality and the Authority to the ALCOSAN sewer system. This flow monitoring shall include monitoring of flows from the CSOs listed in the Municipality's and Authority's NPDES Permit as set forth in 14.e.(iii) below, monitoring of flows from SSOs that are not located on the ALCOSAN interceptor as set forth in Paragraph 14.e.(iii) below, and shall provide protocol-compliant data for joint use by ALCOSAN and the Municipality and the Authority in developing a LTCP and/or Wet Weather Plan (as hereinafter defined in Paragraph 15.b of this Consent Order and Agreement) with a range of practicable alternatives.

b. Flow monitoring shall be performed as per the Allegheny County Health Department ("ACHD") Flow Monitoring Protocol attached hereto and incorporated by reference as Appendix D and according to manufacturer's specifications for the monitoring equipment utilized. Additionally, the flow monitoring program shall:

(i) Provide quality assured/quality controlled data suitable for system hydraulic characterization efforts, wet weather plan development, feasibility studies and associated alternative analyses or regulatory compliance reporting.

(ii) Result in data suitable for the quantification of: (a) base infiltration, (b) dry weather flow and (c) wet weather response.

c. The Municipality and the Authority shall coordinate with ALCOSAN to develop a flow monitoring plan that complements any flow monitoring program implemented by ALCOSAN in accordance with the following:

(i) At least twenty-four (24) months prior to instituting flow monitoring, (i.e. by June 1, 2005), the Municipality and the Authority shall jointly submit a preliminary draft flow monitoring plan to ALCOSAN for comment.

(ii) Eighteen (18) months prior to instituting flow monitoring (i.e. by December 1, 2005), the Municipality and the Authority shall have developed a Flow Monitoring Plan (as described in Appendix D) and shall jointly submit it to ALCOSAN for comment. The Municipality and the Authority shall share with ALCOSAN all available flow monitoring data.

d. Twelve (12) months prior to instituting flow monitoring (i.e. by June 1, 2006), the Municipality and the Authority shall jointly submit the Flow Monitoring

Plan along with any comments by ALCOSAN to the Department for approval. A copy of the Flow Monitoring Plan shall also be submitted to the ACHD for its review and comment. In the event the Department does not approve the submittal, the Municipality and the Authority shall make all corrections required by the Department and shall resubmit the flow monitoring plan to the Department in a time frame specified by the Department. A copy of the re-submission shall also be sent to the ACHD. In the event a dispute arises regarding the corrections to the flow monitoring plan required by the Department under this sub-paragraph, such dispute shall be subject to the Dispute Resolution provisions of this Consent Order and Agreement.

e. The Flow Monitoring Plan shall, at a minimum, include provisions for:

(i) The installation of flow monitors at locations that will document the average daily dry weather flows, the peak hourly dry weather flows, the peak hourly wet weather flows, the total sewage volume during each rainfall event and document and verify the dry and wet weather hydrographs in conformance with Paragraph 14.b.

(ii) Monitoring flow at all points of connection with municipalities and/or authorities whose sanitary and/or combined sewer systems are tributary to that of the Municipality and the Authority and at all points of connection at which the sewer system of the Municipality and the Authority become tributary to the sanitary and/or combined sewer system of another municipality or authority. Best professional judgment may be applied to determine points for flow monitoring where, for example, a collector sewer or trunk sewer follows or crisscrosses municipal and/or authority boundaries creating multiple points of connection between the same municipalities and/or authorities. In such cases, monitoring points shall be established such that flows are monitored where the sewer effectively first enters into the Municipality's and the Authority's sewer system from that of another municipality and/or authority and where the sewer finally leaves the Municipality's and the Authority's sewer system and flows into that of another municipality and/or authority.

(iii) Monitoring flow from all CSOs listed in the Municipality's and Authority's NPDES Permit and all SSOs described in Paragraph 14.a above. If flow cannot feasibly be measured with one or more flow monitoring devices, the Municipality and the Authority shall provide the date and estimate the time, duration, rate and amount of the CSO or SSO. For the purposes of this sub-paragraph, the availability of differential monitoring, in which flows upstream and downstream are monitored and the overflow rate is calculated as the difference, is a feasible flow monitoring alternative.

(iv) If the Municipality and the Authority choose to evaluate the hydraulic performance of their sewer system directly from the flow monitoring data without modeling, the installation of flow monitors at locations that will support this approach.

(v) If the Municipality and the Authority choose to use modeling to evaluate the hydraulic performance of their sewer system, the installation of flow monitors at locations that will support the calibration and verification of the models.

(vi) Monitoring of the sewer system in a manner (A) to calibrate and verify any tools or methodology used to characterize system hydraulics, (B) to provide for development of a Wet Weather Plan, as defined in Paragraph 15.b, (C) to develop a Feasibility Study, as defined in Paragraph 15.c, with associated alternative analyses and (D) to quantify CSO occurrences and SSO occurrences for future compliance monitoring.

(vii) Coordinating flow monitoring activities required by this Paragraph 14 with all municipalities and/or authorities whose sanitary and/or combined sewer systems are either tributary to, or receive flows from, that of the Municipality and the Authority.

(viii) Coordinating flow monitoring activities required by this Paragraph 14 with other municipalities and/or authorities so that monitoring within a given sewershed is conducted at the same time within all municipalities in that sewershed, and so that flows are measured with compatible devices and protocol-compliant methodology. The Department's approval of the Municipality's and the Authority's Flow Monitoring Plan which proposes a coordinated sewershed-based approach may be contingent upon adequate demonstration and documentation of the coordination of the flow monitoring program with the other municipalities in the sewershed.

f. The flow monitoring program shall be scheduled during a period of sufficient time to account for seasonality effects on the sewer system flows. This shall include flow monitoring for a minimum duration of one (1) year, which shall have a total annual rainfall volume of no less than 30.9 inches and which shall include at least two (2) significant rainfall events, excluding any contribution from snow melt, equal to or exceeding one (1) inch of rainfall in a twenty-four (24) hour period. If during the monitoring period the rainfall volume exceeds 30.9 inches and the two (2) significant rainfall events occur in less than one (1) year, the monitoring program may be terminated when such conditions have been met. If during that one year, the total rainfall volume does not equal or exceed 30.9 inches and two such significant rainfall events do not occur, monitoring shall be extended for (i) an additional nine (9) months, or (ii) until such conditions have been met, whichever occurs first.

g. Within 120 days of completion of the flow monitoring program, the Municipality and the Authority shall submit to the Department and ACHD a summary and report of the flow monitoring conducted pursuant to Paragraph 14.e above. The Municipality and the Authority shall also submit all flow monitoring data to ALCOSAN, the Department, ACHD and/or the municipalities and authorities within the sewershed upon their written requests.

h. **Prior Flow Monitoring Data.** If (i) the Municipality and the Authority have demonstrated that the service area tributary to the flow monitor has not changed appreciably since data was collected from the site and (ii) Quality Assurance/Quality Control documentation consistent with Appendix D and this Paragraph 14 exists; data from protocol-compliant flow monitoring (as described in Appendix D) conducted prior to June 1, 2007, but after January 1, 1997 may be used: (A) to inform and refine development of the Municipality's and the Authority's flow monitoring plan with respect to the total number of meters and meter locations; or (B) to supplement new data collected under the regional flow monitoring program required by Paragraph 14.

To obtain approval for use of previous flow monitoring data, the Professional Engineer must submit to the Department a summary and data assessment report of such flow monitoring and data as a supplement to the Municipality's and the Authority's proposed flow monitoring plan be submitted, under Paragraph 14.d. The supplement must provide documentation that the previous flow monitoring and data are protocol-compliant, consistent with Appendix D. The request for approval for use of previous flow monitoring data must include a signed certification statement as set forth in Paragraph 22 of this Consent Order and Agreement.

15. **<u>Feasibility Study in Conjunction with an ALCOSAN Enforcement Order</u>.**

a. For purposes of this Consent Order and Agreement, the term "Enforcement Order" shall mean a Consent Decree or Consent Order and Agreement, or an order issued by a court or tribunal of competent jurisdiction that requires ALCOSAN to develop and implement a regional Wet Weather Plan and/or a LTCP to eliminate SSOs and to provide CSO control in conformance with Federal, State and local laws, and with NPDES Permit requirements. The Enforcement Order must have resulted from a lawsuit or administrative action initiated by the United States of America, Environmental Protection Agency.

b. For purposes of this Consent Order and Agreement, the term "Wet Weather Plan" includes any plan submitted by ALCOSAN to EPA and/or DEP, which incorporates the requirements of a LTCP and/or addresses other wet weather problems in Allegheny County such as SSOs.

c. If on or before July 1, 2008, ALCOSAN is subject to an Enforcement Order, as defined above, then the Municipality and the Authority shall, in accordance with the schedule set forth in the Enforcement Order, participate with and cooperate with ALCOSAN in the development of the Wet Weather Plan and/or LTCP required by the Enforcement Order. Such participation and cooperation by the Municipality and the Authority shall include, but not be limited to:

(i) establishing with ALCOSAN the quantity and rate of sewage flow from the Municipality and the Authority that ALCOSAN will be able to retain, store, convey and treat upon implementation of a Wet Weather Plan and/or LTCP; and

(ii) developing a feasibility study with an alternatives analysis evaluating the Municipality's and the Authority's options to construct sewage facilities necessary to retain, store, convey and treat any sewage flows from the Municipality and the Authority including, but not limited to, any sewage flows that: (A) ALCOSAN cannot accommodate or (B) ALCOSAN could accommodate, but which the Municipality and the Authority decide to address in a separate manner ("Feasibility Study").

d. The Municipality and the Authority shall submit to the Department and ACHD the Feasibility Study within six (6) months after ALCOSAN submits a Wet Weather Plan and/or LTCP to EPA and/or the Department as required by the Enforcement Order. The Feasibility Study shall evaluate a range of alternatives, including but not limited to, alternatives to eliminate SSOs and shall estimate the cost and time necessary to implement or construct each alternative.

16. **Feasibility Study in Conjunction with ALCOSAN in the Absence of an ALCOSAN Enforcement Order.** In the event that ALCOSAN is not subject to an Enforcement Order by July 1, 2008, the Municipality and the Authority shall, commencing on August 1, 2008 and completing on May 31, 2010:

a. participate with ALCOSAN in the development of a LTCP and/or Wet Weather Plan that will resolve the regional wet weather sewer overflow problem by eliminating SSOs and providing for CSO control in conformance with Federal, State and local law and with NPDES Permit requirements;

b. establish with ALCOSAN the quantity and rate of sewage flow from the Municipality and the Authority that ALCOSAN will be able to retain, store, convey and treat; and

c. on or before May 31, 2010, submit to the Department, for approval, and to ACHD for review and comment, a schedule for preparation by the Municipality and the Authority of a LTCP and a plan for the elimination of any SSOs in the Municipality and the Authority, which schedule, upon written approval by the Department, shall be incorporated as an enforceable provision of this Consent Order and Agreement.

17. **Effect of Consent Order and Agreement.** Notwithstanding any other provisions of this Consent Order and Agreement, the parties acknowledge that the Municipality's and the Authority's entry into this Consent Order and Agreement is not intended to, and does not, supersede or alter the terms and/or obligations of (a) any existing agreements between the Municipality and the Authority and ALCOSAN and (b) any existing agreements between or among municipalities relating to sewage. In signing this Consent Order and Agreement, the Municipality and the Authority specifically reserve and do not waive any rights under the foregoing agreements. In addition, this Consent Order and Agreement shall not be construed as to afford third party beneficiary status to any third parties including, without limitation, ALCOSAN, its successors and assigns.

18. **Joint Municipal Scheduling.** The Municipality and the Authority can fulfill some or all of their obligations by entering into a legally binding agreement with one or more municipalities or authorities within a common sewershed, for the purpose of regional project management. In order to complete the tasks in Phase I and Phase II, the Municipality and the Authority may submit to the Department, for its approval, a modified schedule for completing these tasks. The modified schedule need not specify an

equal distribution of these tasks for each municipality within a year; however, on a total regional project basis, the modified schedule completion dates shall not exceed the original completion dates. Each municipality or authority entering into the legally binding agreement shall cooperate with one another to assure the completion of all of these tasks within all of the municipalities represented within the legally binding agreement. Nothing in this Consent Order and Agreement is intended nor shall it be interpreted to prohibit any municipality or authority who enters into the above-referenced joint agreement from seeking and/or obtaining indemnification from any other municipality or authority that is party to the joint agreement. In addition, nothing in this Consent Order and Agreement is intended nor shall it be interpreted to prohibit or preclude any municipality or authority which enters into the above-referenced joint agreement from seeking or obtaining contribution and/or indemnification from any person or entity.

19. **Tap Control Plans.** The Municipality and the Authority, with regard to any tap Control Plan in place as part of a Department-mandated Corrective Action Plan (hereinafter "CAP") shall:

a. Self-regulate connections to portions of its sewer system tributary to ALCOSAN so as not to exacerbate the existing hydraulic overload in its sewer system and/or in any sewer systems into which its sewer system discharges. Self-regulation can continue as long as the Municipality and the Authority are in compliance with this Consent Order and Agreement. The Municipality's and the Authority's compliance with this Consent Order and Agreement shall constitute compliance with any current CAP for portions of its sewer system tributary to ALCOSAN, and the Department will not impose any future restrictions on tap-ins for portions of its sewer system tributary to ALCOSAN as long as the Municipality and the Authority are in compliance with this Consent Order and Agreement.

b. In areas with known basement backups of sewage contributed to by the Municipality's and/or the Authority's sewer system, provide for interim protection against basement backups. Methods of protection shall include, but not be limited to, the installation of municipally maintained backflow preventers and/or pressurized laterals.

c. Notwithstanding any other provision or term of this Consent Order and Agreement, submit to the Department and ACHD all necessary planning modules and revisions for any new connections required by Chapter 71 of DEP's rules and regulations, 25 Pa. Code §§ 71.1, *et seq*.

20. **NPDES Permit Issuance.** The Department will, simultaneously with the execution of this Consent Order and Agreement, issue an NPDES Permit to the Municipality and the Authority. The NPDES Permit is attached hereto as Appendix F. The Municipality and the Authority waive their rights to appeal the issuance of the NPDES Permit so long as the terms, conditions, provisions and limitations in the NPDES Permit are equal to or less stringent than those in Appendix F.

21. **Additional Information.** If the Department and/or the ACHD requires additional information for any submittal pursuant to this Consent Order and

Agreement, NPDES Permit and/or laws and regulations of the Commonwealth of Pennsylvania or the United States, the Municipality and the Authority shall provide such additional information to the Department within fifteen (15) days unless a longer time is specified in the Department notice.

22. **Semi-Annual Progress Reports.** The Municipality and the Authority shall submit semi-annual written reports (attached hereto as Appendix E) to the Department and ACHD of their efforts to comply with the obligations set forth in Paragraphs 3 through 16 and 18 and 19 above until those obligations are completed. Said report shall be sent to the address in Paragraph 30 and submitted to the Department and ACHD no later than the 31st day of January and July of each year. The first semi-annual progress report shall be due by July 31, 2004 and shall cover the period of January 1 through June 30, 2004. The first semi-annual progress report shall also include a detailed list of all prior work that meets the criteria set forth in Paragraphs 4, 5, 6, 7 and 9 for credit toward compliance with the Municipality's and the Authority's obligations under this Consent Order and Agreement. In addition to the detailed list of prior work, the Municipality and the Authority shall also submit a "Credit for Past Work Form" signed by a municipal representative. The Credit for Past Work Form is attached hereto as Appendix G and must be signed, with the following certification:

> I certify under the penalty of law that I believe the information provided in this document is true, accurate, and complete. I certify under penalty of law that I am familiar with the information submitted in this document and all attached documents and, to the best of my knowledge, information and belief and based on my inquiry of those

individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

Within sixteen (16) months of the submittal, the Department will issue a decision accepting or rejecting the Municipality's and the Authority's claim for past work. In the event that a dispute should arise as to the Department's decision in this matter, that shall be subject to the Dispute Resolution provision of this Consent Order and Agreement. If the Department fails to make a decision concerning the credit for past work within sixteen (16) months, the Municipality's and the Authority's request for Credit for Past Work will be deemed approved provided that the information in the Municipality's and the Authority's submittal for credit for past work was not false. If during the term of this Consent Order and Agreement, even after the sixteen (16) month period from submittal, the Department discovers that the Municipality and the Authority submitted materially false information, the deemed approval provision of this Paragraph 22 will be null and void and of no effect as to the affected task(s) (i.e. Physical Surveys/Visual Inspections, CCTV, Sewer System Mapping, Sewer System Dye Testing or System Hydraulic Characterization) and the Municipality and the Authority shall be responsible for fully complying with all the requirements of the Paragraph(s) of this Consent Order and Agreement that required such task(s) without receiving credit for any past work for such task(s).

23. **Record Keeping.**

a. The Municipality and the Authority shall maintain copies of any records, reports, plans, data, permits and documents, related to or developed pursuant to this Consent Order and Agreement, including any underlying research and data, for a period of five (5) years beyond the termination date of this Consent Order and Agreement. The Municipality and the Authority shall require any independent contractor, employee, agent or officer implementing any portion of this Consent Order and Agreement to also retain such materials for a period of five (5) years beyond the termination date of this Consent Order and Agreement. The Municipality and the Authority shall submit such supporting documents to the Department and ACHD upon request.

b. The Municipality and/or the Authority shall notify the Department and ACHD ninety (90) days prior to disposal or destruction of such records at the end of this five (5) year period and shall, upon the request of the Department or ACHD, deliver such records to the Department or ACHD prior to such disposal or destruction.

24. **Municipal Cooperation.** The Municipality and the Authority must diligently cooperate with each other to comply with the terms and conditions of this Consent Order and Agreement and implement the Department ordered milestones and schedules herein.

25. **Stipulated Civil Penalties.**

a. In the event the Municipality and/or the Authority fail to comply in a timely manner with any term or provision of this Consent Order and Agreement applicable to it, the Municipality and/or the Authority shall be in violation of this Consent Order and Agreement and, in addition to other applicable remedies, shall pay a civil penalty per day for each violation as follows:

(i) Days 1 through 14 of each violation - $100 per day per violation;

(ii) Days 15 through 30 of each violation - $200 per day per violation;

(iii) Days 31 through 60 of each violation - $300 per day per violation; and

(iv) Days 61 and beyond of each violation - $500 per day per violation.

b. Stipulated civil penalty payments shall be payable monthly on or before the fifteenth day of each succeeding month. Fifty percent of the amount payable shall be made by certified check or the like, made payable to the "Commonwealth of Pennsylvania, Clean Water Fund" and shall be sent to the address in Paragraph 30. Fifty percent of the amount payable shall be made by certified check or the like, made payable to the "Allegheny County Environmental Health Fund" and shall be sent to Geoffrey M. Butia, Chief, Public Drinking Water and Waste Management, Allegheny County Health Department, 3901 Penn Avenue, Building #5, Pittsburgh, Pennsylvania 15222-1318.

c. Any payment under this Paragraph shall neither waive the Municipality's and/or the Authority's duty to meet their obligations under this Consent Order and Agreement nor preclude the Department or ACHD from commencing an action to compel the Municipality's and/or the Authority's compliance with the terms and conditions of this Consent Order and Agreement. The payment resolves only the Municipality's and/or the Authority's liability for civil penalties arising from the violation of this Consent Order and Agreement for which the payment is made.

d. Stipulated civil penalties shall be due automatically and without notice.

26. **Additional Remedies.**

a. In the event the Municipality and/or the Authority fail to comply with any provision of this Consent Order and Agreement, the Department may, in addition to the remedies prescribed herein, pursue any remedy available for a violation of an order of the Department, including an action to enforce this Consent Order and Agreement.

b. The remedies provided by this Paragraph and Paragraph 25 (Stipulated Civil Penalties) are cumulative and the exercise of one does not preclude the exercise of any other. The failure of the Department to pursue any remedy shall not be deemed to be a waiver of that remedy. The payment of a stipulated civil penalty, however, shall preclude any further assessment of civil penalties for the violation for which the stipulated civil-penalty is paid.

27. **Reservation of Rights.** The Department and the ACHD reserve the right to require additional measures to achieve compliance with applicable law. The Municipality

and the Authority reserve the right to challenge any action which the Department and the ACHD may take to require those measures.

28. **Liability of the Municipality and the Authority.** The Municipality and the Authority shall be liable for any of their respective violations of the Consent Order and Agreement, including those caused by, contributed to, or allowed by their officers, agents, employees, or contractors. The Municipality and the Authority also shall be liable for any violation of this Consent Order and Agreement caused by, contributed to, or allowed by their successors and assigns unless the Department terminates the Municipality's and/or the Authority's duties and obligations under this Consent Order and Agreement pursuant to Paragraph 29.c below.

29. **Transfer of Site.**

a. The duties and obligations under this Consent Order and Agreement shall not be modified, diminished, terminated or otherwise altered by the transfer of any legal or equitable interest in the Municipality's and the Authority's sewer system or any part thereof unless agreed to by the Department as set forth in sub-Paragraph 29.c below.

b. If the Municipality and/or the Authority intends to transfer any legal or equitable interest in their sewer system, the Municipality and/or the Authority shall serve a copy of this Consent Order and Agreement upon the prospective transferee of the legal and equitable interest at least thirty (30) days prior to the contemplated transfer and shall simultaneously inform the Regional Office of the Department and the ACHD of such intent.

c. The Department in its reasonable discretion may agree to modify or terminate the Municipality's and/or the Authority's duties and obligations under this Consent Order and Agreement upon transfer of the Municipality's and/or the Authority's sewer system to an entity that agrees to and is capable of complying with the terms and conditions of this Consent Order and Agreement. In the event a dispute should arise as to the Department's decision in this matter, that shall be subject to the Dispute Resolution provision of this Consent Order and Agreement.

30. **Correspondence with the Department and the ACHD.** All correspondence with the Department concerning this Consent Order and Agreement shall be addressed to:

Paul Eisworth
CSO Coordinator
400 Waterfront Drive
Pittsburgh, PA 15222-4745
Phone: 412-442-4000
Fax: 412-442-4328

All correspondence with the ACHD concerning this Consent Order and Agreement shall be addressed to:

Geoffrey M. Butia, Chief
Public Drinking Water and Waste Management
Allegheny County Health Department
3901 Penn Avenue, Building #5
Pittsburgh, PA 15224-1318
Phone: 412-578-8040
Fax: 412-578-8053

31. **Correspondence with the Municipality and the Authority.** All correspondence with the Municipality concerning this Consent Order and Agreement shall be addressed to:

CBL for PWSA

Guy Costa, Director
Department of Public Works
City of Pittsburgh
611 Second Avenue
Pittsburgh, PA 15219
Phone: 412-255-2727
Fax: 412-255-8981

with copy to:
Jacqueline Morrow
Suite 313, City/County Bldg
414 Grant Street
Pittsburgh, PA 15219
412-255-2010
412-255-2285

All correspondence with the Authority concerning this Consent Order and Agreement shall be addressed to:

Gregory F. Tutsock, Executive Director
Pittsburgh Water and Sewer Authority
441 Smithfield Street
Pittsburgh, PA 15222
Phone: 412-255-8949
Fax: 412-393-0522

with a copy to:
Clifford B. Levine
Thorp, Reed & Armstrong LLP
One Oxford Centre, Suite 1400
Pittsburgh, PA 15219
phone 412-394-2396
fax 412-394-2555

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with a copy to:

Michael Lichte, Environmental Compliance Coordinator
Pittsburgh Water and Sewer Authority
441 Smithfield Street
Pittsburgh, PA 15222
Phone: 412-255-2579
Fax: 412-393-0522

CAO
BMH
JMTJ

The Municipality and/or the Authority shall notify the Department whenever there is a change in the contact person's name, title, or address. Service of any notice or any legal process for any purpose under this Consent Order and Agreement, including its enforcement, may be made by mailing a copy by first class mail to the above address.

32. **Force Majeure.**

a. In the event that the Municipality and/or the Authority is prevented from complying in a timely manner with any time limit imposed in this Consent Order and Agreement solely because of a strike, fire, flood, act of God, or other circumstances beyond the Municipality's and/or the Authority's control and which the Municipality and/or the Authority, by the exercise of all reasonable diligence, are unable to prevent, then the Municipality and/or the Authority may petition the Department for an extension of time. An increase in the cost of performing the obligations set forth in this Consent Order and Agreement shall not constitute circumstances beyond the Municipality's and/or the Authority's control. The Municipality's and/or the Authority's economic inability to comply with any of the obligations of this Consent Order and Agreement shall not be grounds for any extension of time.

b. The Municipality and/or the Authority shall only be entitled to the benefits of this Paragraph if it notifies the Department and the ACHD within five (5) working days by telephone and within ten (10) working days in writing of the date it becomes aware or reasonably should have become aware of the event impeding performance. The written submission shall include all necessary documentation, as well as a notarized affidavit from an authorized individual specifying the reasons for the delay, the expected duration of the delay, and the efforts which have been made and are being made by the Municipality and/or the Authority to mitigate the effects of the event and to minimize the length of the delay. The initial written submission may be supplemented within 10 working days of its submission. The Municipality's and/or the Authority's failure to comply with the requirements of this Paragraph specifically and in a timely fashion shall render this Paragraph null and of no effect as to the particular incident involved.

c. Commercial Unavailability. The Municipality and/or the Authority shall be solely responsible for compliance with any applicable deadline or the performance of any work described in this Consent Order and Agreement that requires the acquisition and installation of equipment or contracting with a vendor. If it appears that the commercial unavailability of equipment or vendor may delay the Municipality's and/or the Authority's performance of work according to the applicable implementation schedule, the Municipality and/or the Authority shall notify the Department and the ACHD in accordance with the requirements of Paragraph 32.b of any such delays as soon as the Municipality and/or the Authority reasonably concludes that the delay could affect its ability to comply with the implementation schedule. The Municipality and/or the Authority shall propose a modification to the applicable schedule of implementation set forth herein. Prior to the notice required by this Paragraph, the Municipality and/or the Authority must have undertaken reasonable efforts to obtain such equipment and/or contacted a reasonable number of vendors and obtained a written representation that the equipment and/or the vendor(s) are in fact commercially unavailable. In the notice, the Municipality and/or the Authority shall reference this Paragraph, identify the milestone date(s) they contend they will not be able to meet, provide the Department and the ACHD with written correspondence to the vendor identifying efforts made to secure the equipment and/or services of the vendor, and describe the specific efforts the Municipality and/or the Authority have taken and will continue to take to find such equipment or vendor. The Municipality and/or the Authority may propose a modified schedule or modification of other requirements of this Consent Order and Agreement to address such commercial unavailability.

d. The Department, in consultation with the ACHD, will decide whether to grant all or part of the extension requested on the basis of all documentation submitted by the Municipality and/or the Authority and other information available to the Department and the ACHD. In any subsequent litigation, the Municipality and/or the Authority shall have the burden of proving that the Department's refusal to grant the requested extension was an abuse of discretion based upon the information then available to it.

33. **Dispute Resolution.**

a. The Municipality and/or the Authority may initiate dispute resolution under this Paragraph in response to any decision of the Department under this Consent Order and Agreement involving the following matters: (i) the modification or disapproval of any flow monitoring plan submitted by the Municipality and/or the Authority to the Department pursuant to Paragraph 14; (ii) a dispute regarding the NMC Reports pursuant to Paragraph 13; (iii) the Department's disapproval of the transfer of the Municipality's and/or the Authority's duties and obligations hereunder pursuant to Paragraph 29.c; (iv) the Department's modification or disapproval of prior work completed by the Municipality and/or the Authority for which it desires credit toward its compliance with Paragraphs 4, 5, 6, 7, 8 and 9 of this Consent Order and Agreement; and

(v) the Department's disapproval of a schedule submitted under Paragraph 16.c. The Municipality and/or the Authority shall bear the burden of proving that the disputed action on the part of the Department was an abuse of discretion based upon the information then available to it.

b. To initiate dispute resolution, the Municipality and/or the Authority shall provide written notice to the Water Management Program Manager of the Department's Southwest Regional Office (or equivalent position) (the "Manager") within ten (10) days of receiving the Department's decision. The Municipality and/or the Authority shall have an additional ten (10) days to provide the Department with a written list of objections to the decision in dispute (the "Statement of Position"). The Department shall have twenty (20) days to provide its Statement of Position.

c. Within twenty (20) days following receipt of the Department's Statement of Position, the Municipality's and/or the Authority's representative(s) and the Manager shall meet and confer in an attempt to resolve the dispute. In the event the parties are unable to resolve the dispute within this period, the Manager will issue a decision concerning the dispute. Either party may request a review of the Manager's decision by the Regional Director of the Department's Southwest Regional Office (the "Regional Director") within ten (10) days of its receipt of the Manager's decision. The Statements of Position shall be provided to the Regional Director to issue a decision regarding the dispute.

(i) For matters described in subparts a. (i) and (ii) of this Paragraph, the Regional Director's decision shall be a decision under this Consent Order and Agreement subject to Paragraph 39.

(ii) For matters described in subparts a. (iii), (iv) and (v) of this Paragraph, the Regional Director's decision shall constitute a final action under 25 Pa. Code § 1021.2, and Municipality and/or the Authority shall have the right to an appeal to the Environmental Hearing Board ("EHB"). The parties agree to jointly request the EHB to expedite any proceedings related to an appeal under this Paragraph.

d. During the pendency of the dispute resolution process set forth above, neither the Municipality nor the Authority shall be obligated to perform any work which is the subject of or which performance is directly dependent on the resolution of the dispute. All other obligations and activities shall be completed in accordance with the terms of the Consent Order and Agreement. Stipulated civil penalties with respect to the disputed matter shall continue to accrue from the first day of noncompliance with any applicable provision of this Consent Order and Agreement, but payment shall be stayed pending resolution of the dispute as provided in this Paragraph. In the event the Municipality and/or the Authority do not prevail on the disputed issue, stipulated penalties shall be paid as provided in Paragraph 25 (Stipulated Civil Penalties). In the event the Municipality and/or the Authority prevail on the disputed issue, stipulated civil penalties shall not be due and owing.

e. Any time period for dispute resolution set forth herein may be extended by written agreement of the parties.

34. **Severability.** The paragraphs of this Consent Order and Agreement shall be severable and should any part hereof be declared invalid or unenforceable, the remainder shall continue in full force and effect between the parties.

35. **Entire Agreement.** This Consent Order and Agreement shall constitute the entire integrated agreement of the parties. No prior or contemporaneous communications or prior drafts shall be relevant or admissible for purposes of determining the meaning or intent of any provisions herein in any litigation or any other proceeding.

36. **Attorney Fees.** The parties shall bear their respective attorney fees, expenses and other costs in the prosecution or defense of this matter or any related matters, arising prior to execution of this Consent Order and Agreement.

37. **Modifications.** No changes, additions, modifications, or amendments of this Consent Order and Agreement shall be effective unless they are set out in writing and signed by the parties hereto.

38. **Titles.** A title used at the beginning of any paragraph of this Consent Order and Agreement may be used to aid in the construction of that paragraph, but shall not be treated as controlling.

39. **Decisions under Consent Order and Agreement.** Except as provided in Paragraph 33.c(ii), any decision which the Department makes under the provisions of this Consent Order and Agreement is intended to be neither a final action under 25 Pa. Code

§ 1021.2, nor an Adjudication under 2 Pa.C.S. § 101. Any objection which the Municipality and/or the Authority may have to the decision will be preserved until the Department enforces this Consent Order and Agreement.

40. **Scope of Order.** Notwithstanding any other provision of this Consent Order and Agreement, this Consent Order and Agreement shall not apply to any portion of the Municipality and/or the Authority sewer system that is within the Nine Mile Run Watershed and is subject to a separate Consent Order and Agreement dated May 22, 2000 between the Department and the Borough of Edgewood, the Borough of Swissvale, the Borough of Wilkinsburg, the City of Pittsburgh and the Pittsburgh Water and Sewer Authority.

41. **Termination.** The obligations of this Consent Order and Agreement shall terminate on June 30, 2012, or when the Department determines, in consultation with the ACHD, that the Municipality and the Authority have complied with the terms and conditions of this Consent Order and Agreement, whichever occurs first. Notwithstanding any other provision of this Consent Order and Agreement, the obligations of the NMCs shall continue as obligations for the Municipality and the Authority as condition of the NPDES Permit as renewed or reissued from time to time.

42. **Resolution.** Attached hereto and incorporated by reference as Appendix H is a resolution of the Municipality authorizing its signatories below to enter into this Consent Order and Agreement on its behalf.

43. **Resolution.** Attached hereto and incorporated by reference as Appendix I is a resolution of the Authority authorizing its signatories below to enter into this Consent Order and Agreement on its behalf.

IN WITNESS WHEREOF, the parties hereto have caused this Consent Order and Agreement to be executed by their duly authorized representatives. The undersigned representatives of the Municipality and the Authority certify under penalty of law, as provided by 18 Pa.C.S. § 4904, that they are authorized to execute this Consent Order and Agreement on behalf of the Municipality and the Authority; that the Municipality and the Authority consent to the entry of this Consent Order and Agreement as a final ORDER of the Department; and that the Municipality and the Authority hereby knowingly waive their rights to appeal this Consent Order and Agreement and to challenge its content or validity, which rights may be available under Section 4 of the Environmental Hearing Board Act, the Act of July 13, 1988, P.L. 530, No. 1988-94, 35 P.S. § 7514; the Administrative Agency Law, 2 Pa.C.S. § 103(a) and Chapters 5A and 7A; or any other provision of law. Signature by the Municipality's and the Authority's attorney certifies only that the agreement has been signed after consulting with counsel.

FOR THE PITTSBURGH WATER AND SEWER AUTHORITY:

Name JOSEPH PRESTON Jr
Title CHAIRMAN

Name RICHARD M. FEES
Title VICE CHAIRMAN

Name Clifford B. Levine
Attorney for the Pittsburgh Water and Sewer Authority

FOR THE COMMONWEALTH OF PENNSYLVANIA, DEPARTMENT OF ENVIRONMENTAL PROTECTION:

Name Charles A. Duritsa
Title Regional Director DEP

Name Bruce M Herschlag
Assistant Counsel

FOR THE CITY OF PITTSBURGH:

Name TOM MURPHY
Title MAYOR

Name GUY COSTA
Title DIRECTOR, Public WORKS

Name JACQUELINE MORROW
Attorney for the City of Pittsburgh

FOR THE ALLEGHENY COUNTY HEALTH DEPARTMENT:

Name Bruce W. Dixon, M.D.
Title Director

Name Henry Miller ~~III~~
Attorney for Allegheny County Health Department

Appendix A
GIS PROTOCOL

INTRODUCTION

The physical inspections required in the Consent Order and Agreement are intended to provide four categories of information for inclusion on comprehensive sewer maps:

- General information on the configuration of sewer manholes and their connecting pipes to provide field verification for sewer system mapping
- General information on the condition of sewer manholes and pipes to identify any non-structural operation and maintenance (O&M) needs such as, but not limited to, accumulated sediment and debris deposits, shifted manhole frames, or unsafe manhole steps
- General information regarding sewage pump stations; their configuration, operation, hydraulic capacities, and back-up power sources; force mains; inverted siphons and their condition
- Identify defects related to structural stability, excessive infiltration or inflow, evidence of present or prior surcharging or overflows, hydraulic restrictions, and any other conditions that would compromise and/or diminish the capacity of the sanitary and/or combined sewer system

In order for the Municipality and the Authority to create an updated, comprehensive sewer map of the sanitary and/or combined sewers within its sewer system, directly or indirectly tributary to the ALCOSAN Sewer System, the Municipality and the Authority may build upon the base sewer map that has been created by the 3 Rivers Wet Weather Demonstration Program (3RWWDP), or a comparable base sewer map. The comprehensive sewer map shall be submitted in Environmental Systems Research Institute (ESRI)-compatible format, and shall indicate, at a minimum, the location of the sewer lines, the direction of flow, the size of the sewer lines, the sewer line material, the locations where flows from other municipalities enter the sewer system, the field-verified location of manholes and the location of catch basins connected to the sewer system (identified by a comprehensive numbering or lettering system), the location of pump stations, force mains, and siphons, and the location of streams or drainage ways tributary to the sewers. These maps shall be created using Geographic Information System (GIS) mapping and verified using Global Positioning System (GPS) ground monitoring or land surveying methods. The GIS mapping shall include the use of the specified attribute tables, data dictionary, etc., defined in this protocol. The maps must include street names, municipal boundaries, and streams. This base data is available from the Allegheny County Division of Computer Services from Kathryn Ross, at 412-350-5126. Additionally, maps should include points of interconnection with other municipal or private sewer systems and any known points of sewer overflow including combined sewer overflows and sanitary sewer overflows (SSOs), including manhole overflows and basement back-ups from the public sewer. The investigations conducted in preparing these maps shall include the location of any buried or lost manholes through metal detection, CCTV or excavation, the identification of all unsewered residential areas within the sewer system and the associated estimated population of these unsewered residential areas.

PART 1: TECHNICAL REQUIREMENTS

A. All significant sewer system structures such as manholes, regulating chambers, SSO outfalls, pump stations, or other appurtenances should be located to a minimum horizontal accuracy of three (3) feet. Coordinates should be recorded as "real coordinates" in State Plane Pennsylvania South NAD83. Vertical survey information should reference the NGVD88 datum. A spatial data projection file should be included in ESRI format noting the projection and datum used.

B. Structure locations may be determined using the following alternative methods:

- Existing "as-built" sewer system maps, as long as the maps have been field-verified, digitized, and rectified to the existing GIS base maps, or
- Using a GPS where conditions allow, or
- Using traditional land surveying methods

C. In some geographic areas traditional surveying methods may be more productive than using GPS and, in some cases, a combination of above methods may be required. With regard to GPS data collection, additional information such as the number of readings used to define a point; standard deviation of values and the type of data correction should be recorded. The type of data correction can either be real time, post process or raw. The type of equipment and operator should also be included. Adherence to this minimum acceptable requirement will ensure that field verified data throughout the area are consistent.

D. For most of the Municipality's and the Authority's sewer system, the precise elevations of manhole covers and manhole inverts are not required. However, surveyed manhole inverts, rim elevations, dam heights, overflow pipe elevations and slopes are required to a minimum vertical accuracy of 0.10 feet for regulator structures, structures that directly affect hydraulic performance and SSO and/or CSO outfalls. Manhole inverts and rim elevations of all accessible manhole structures on trunks sewers shall also be surveyed to a minimum vertical accuracy of 0.10 feet when:

- The sanitary sewer pipe has a diameter of 10 inches or greater, or
- The combined sewer pipe has a diameter of 24 inches or greater, or
- The sewer pipe is connected to an ALCOSAN interceptor, in which case survey data will be required for a distance of 600 linear feet above the point of connection with ALCOSAN, or
- The sewer pipe segment needs more precise invert and slope data to meet the objectives of the hydraulic capacity evaluations.

If the data referenced in this Paragraph has been completed by ALCOSAN, the Municipality and the Authority are not required to duplicate this work, but must obtain the necessary documentation from ALCOSAN.

E. Digital data for basic sewer configuration, such as manhole locations, pipe sizes and materials, and manhole depths, will be entered into attribute tables within the 3RWWDP regional GIS system.

PART 2: GIS ATTRIBUTE DATA

The 3 Rivers Wet Weather Demonstration Program (3RWWDP) has created a GIS base sewer map from the information provided by the communities and/or municipal engineering firms. Using existing municipal GIS mapping, computer drawn maps (CAD), or paper maps converted by heads up digitizing, standardized system base maps were created. All of these individual maps were used to build a comprehensive, though not comprehensively field verified, system-wide map.

This protocol will serve as a guide for the creation of an updated GIS sewer map. It is critical that all municipalities use standard field names and formats so the GIS data collected from each municipality/authority can be easily and cost-effectively integrated to form a complete system-wide map for the ALCOSAN service area.

The Data Dictionary defines the most common fields and field values. While the Data Dictionary does not include all possible fields or field values, the primary aspects of mapping a sewer system are covered. The primary aspects that are covered in the dictionary relate to the physical description and location of the appurtenances and may not be complete enough for an evaluation. If additional fields must be added, for example the manhole inspection reports, then those fields or values should be described in the metadata, the documentation accompanying the GIS data.

2.01 **GIS Sewer Data Dictionary:** The most recent version of the Sewer Data Dictionary which is in the process of being developed and maintained by Allegheny County.

PART 3: METADATA

Metadata documentation should be compiled and maintained. Metadata documentation should explain the accuracy, source, projection and datum, update schedule, etc., for the comprehensive GIS mapping. Metadata should conform to the standards developed by

PaMagic, an organization developing statewide standards, or comparable metadata standards based on the Federal Geographic Data Committee's (FGDC) metadata standard. The entire Metadata Workbook can be found at www.fgdc.gov/metadata.

PART 4: REVIEW AND ACCEPTANCE CRITERIA

All sewer-mapping products generated to be in compliance with this Consent Order and Agreement shall be submitted to:

Pennsylvania Department of Environmental Protection
Southwest Regional Office
Attn: Water Management Program
400 Waterfront Drive
Pittsburgh, PA 15222-4745

Data submissions should be made on CD/DVD ROM and should be accompanied by a cover letter describing the contents of the disk. The data format should be consistent with the specifications outlined in the GIS protocols, i.e. ESRI compatible format. The data files should include projection files and metadata files.

Should the submitted data fail to meet the requirements of the GIS protocols, the data will be returned to the Municipality and the Authority with a cover letter indicating the deficiencies along with a description of the necessary corrections and/or additions.

Appendix B- Relational Database Example
Sewer Segments

Pipe Segment (1)	Pipe Size (in)	Cleaned (date)	TV (date)	Deficiency Noted (May use NASSCO code identification)	Deficiency Corrected (Y/N)	Hydraulic Capacity (mgd)
1-2	24	1/14/03	1/14/03	Collapsed Pipe	Y	
2-3	24	1/14/03	1/14/03			
3-4	24	1/14/03	1/14/03			
4-5	24	1/14/03	1/14/03			
5-6	24	1/14/03	1/14/03			
6-7	10	1/14/03	1/14/03			
7-8	10	1/14/03	1/14/03	Deformed Pipe	Y	
8-9	10					
9-10	10					
10-11	10					
11-12	10					
12-13	10					
13-14	8					
14-15	8					
15-16	8	1/22/03		Fractured Pipe		
16-17	8					
17-18	8					
18-19	8					
19-20	8					
20-21	8					
21-22	8					

(1) Pipe Segment must be identical to the naming convention used in the GIS Map. Some municipalities identify the pipe segment from upstream manhole to downstream manhole (1-2).

Appendix B- Relational Database Example
Sewer Structures

Type of Structure	Structure Identification (1)	Field Verified (Y/N)	Deficiency Noted (May use NASSCO code identification)	Deficiency Corrected (Y/N)	Notes
MH	1	Y	Missing Brick	Y	
MH	2	Y			
MH	3	Y			
MH	4	Y			
MH	5	Y			
MH	6	Y			
MH	7	N	Not located	N	
MH	8	Y			
MH	9	Y			
MH	10	Y			
Siphon	32A	Y	Blocked Barrel	Y	
Siphon	32B	Y	Blocked Barrel	Y	
MH	11	Y			
MH	12	Y			
MH	13	Y	Fractured Rim	Y	
MH	14	Y			
MH	15	Y			
MH	16	Y			
Pump Station	Jones	Y	Stand-by Pump not working	N	
MH	17	Y			
MH	18	Y			

(1) Structure Identification must be identical to the naming convention used in your GIS map

APPENDIX C

The Municipality and the Authority shall submit the Nine Minimum Controls ("NMC") Reports required by Paragraph 13 of this Consent Order and Agreement in a manner consistent with EPA guidance, Combined Sewer Overflows, Guidance for Nine Minimum Controls, 832-B-95-003, May 1995. The actions taken and documented in the NMC Report shall include, at a minimum:

NMC #1 - Proper Operation and Maintenance ("O & M")

a. Identification of staff and resources necessary to implement an adequate O & M program
b. Schedules for preventative and corrective maintenance
c. Response to non-routine maintenance and emergency situations
d. Systematic training of O & M personnel
e. Periodic review and update of O & M program

NMC #2 - Maximum Use of the Collection System for Storage

a. Regular inspection of the municipal collector sewer system and removal of accumulated debris and solids
b. Regular inspection of flap gates to prevent backflow into the system
c. Identification and utilization of opportunities for additional storage within the system, upstream storm water detention and reduction of inflow (see, e.g., Combined Sewer Overflow Technology Fact Sheet, Inflow Reduction, 832-F-99-035, EPA, September 1999).

NMC #3 - Modification of the Pretreatment Program

a. Coordination with ALCOSAN to identify potentially significant non-industrial users
b. Maintenance of inventories of significant non-domestic facilities and assessment of the potential impacts of those non-domestic discharges on CSOs
c. Coordination with ALCOSAN unusual flows or conditions in the municipal sewer system

APPENDIX C

NMC #4 - Maximizing Flow to the Treatment Plant

a. Maximization of flows to ALCOSAN owned and/or operated sewers through regular cleaning of collector sewers, trunk sewers and catch basins as well as maintenance of municipal regulators and flap gates.
b. Performance of hydraulic assessments and modifications of the municipal collection systems as needed to optimize the hydraulic performance of the system.
c. Provision of backflow prevention for the CSOs owned and/or operated by the municipality

NMC #5 - Eliminate Chronic Dry Weather Overflows

a. Performance of regular inspections, preventive and corrective maintenance to prevent dry weather overflows
b. Inspection of regulator structures owned and/or operated by the municipality to promptly identify and mitigate storm induced overflows after storm events
c. Assessment to identification of chronic dry overflows and development of a plan to eliminate the same

NMC #6 - Control of Solids and Floatable Materials

a. Performance of catch basin cleaning and sewer flushing on scheduled basis
b. Performance of field investigations to verify that solids and floatables control mechanisms are in place and in proper working order
c. Modification of existing catch basins as necessary to trap solids and floatables
d. Performance of street sweeping on a regularly scheduled basis
e. Performance of community awareness programs to address street litter
f. Enforcement municipal sewer use, litter and refuse disposal measures
g. Placement and maintenance of trash receptacles in areas where the public congregates to minimize street litter

APPENDIX C

NMC #7 - Pollution Prevention Programs

a. Maintenance of public trash receptacles at key locations along streets, parks and business districts
b. Provision of support mechanisms for the collection of household hazardous wastes
c. Provision of public education (re: source control, recycling, etc.) and stenciling of storm drains
d. Cooperation with ALCOSAN to begin and maintain public recycling, proper disposal of wastes and proper application of fertilizer

NMC #8 - Public Notification of Overflow Occurrences and Impacts

a. Assistance and supplementation of ALCOSAN and ACHD efforts to educate the public, including through the River Recreation Advisory Program and the hotline
b. Provision of a sign, 2 feet by 4 feet in size with red lettering on a yellow background, at each CSO owned and/or operated by the municipality. Each sign shall bear the following language: "These waters receive sewage from sewer overflows during rain events. Please avoid contact with these waters at this time. For more information please call [insert appropriate municipality contact number]."
c. Cooperation with ALCOSAN in its efforts to post the same sign at any CSO owned and/or operated by ALCOSAN that is located within the geographic boundaries of the municipality.
d. Maintenance of a local public notification system that informs the public of appropriate action to take in the event of CSO discharges, particularly discharges from manholes, backups into basements and other discharges with which the public may have more immediate and/or intense contact.

NMC #9 - Monitoring to Characterize CSO Impacts

a. Inspection (visual) of CSO discharges from outfalls listed in the NPDES permit
b. Characterization of the frequency, duration, and volume of discharges from CSO
c. Summarization of CSO discharges on a monthly basis

In the event the Department requests any modification to this NMC Report, the Municipality and the Authority shall make all corrections required by the Department. The Municipality and the Authority shall implement the activities identified in this NMC Report.

Appendix D:

ALLEGHENY COUNTY HEALTH DEPARTMENT FLOW MONITORING PROTOCOL

PART 1: OVERSIGHT

A. The Municipality and the Authority shall employ the services of a professional engineer to oversee the completion of all flow monitoring and planning tasks.

PART 2: MONITORING PLAN REQUIREMENTS

A. The Flow Monitoring Plan shall provide data suitable for developing an LTCP/Wet Weather Control Plan.

B. The Flow Monitoring Plan shall include all of the items stipulated in Paragraph 14 of the Consent Order and Agreement.

C. The Flow Monitoring Plan shall contain at a minimum the following items:

- A GIS map showing the location of all flow monitoring sites
- A delineation of the sewered area for each flow monitor
- The Flow monitoring Technique to be employed
- Manufacturer of Flow Monitors to be used at each site
- Monitoring Crew experience conducting Flow Monitoring
- Approaches to monitoring at or near overflows
- A Data Quality Assurance and Control Plan
- Methods to be used in approximating overflow volume, frequency and duration

D. Flow monitoring shall be performed as per the approved monitoring plan and according to manufacturer's specifications for the monitoring equipment utilized.

PART 3: RAIN DATA

A. An approved Monitoring Plan shall designate a rain gage as a source of rainfall data. The Radar Calibrated Rainfall Network is an approved source of rainfall data. The Municipality and the Authority shall use either the nearest available existing rain gage or propose to install a new rain gauge at an appropriate location. Use of a multiple gage network may be necessary and appropriate. Use of data from alternate sources shall be qualified on a case-by-case basis and subject to the approval of the Department.

PART 4: MONITORING LOCATIONS

A. Monitoring sites shall be designated following field inspection to determine optimal monitoring locations, in conformance with Paragraph 14 of the Consent Order and Agreement.

B. Field investigations shall verify that monitoring locations conform to the requirements of Paragraph 14 of the Consent Order and Agreement.

C. Field investigations shall be conducted at selected monitoring locations to verify that hydraulic, site access, safety, and maintenance conditions are suitable for successful flow monitoring. Flow regime conditions such as surface turbulence and backwater interference from downstream pipes and structures shall be recorded. Observed site conditions shall be documented using standardized forms.

D. If the field investigation reveals that the required site is not suitable for successful flow monitoring, an alternate site shall be selected that most closely meets the requirements stipulated in Paragraph 14 of the Consent Order and Agreement.

PART 5: MONITORING AT OVERFLOW STRUCTURES

A. Following field evaluation, the feasibility of monitoring to quantify flows from an overflow shall be documented. A site-specific monitoring plan shall then be prepared in advance of monitoring overflow points. At a minimum, the overflow monitoring plan shall contain a description of the overflow, a dimensioned sketch, the proposed monitoring approach and/or technology to be used.

B. The overflow monitor points shall be interrogated every three days following the start of monitoring until the equipment is performing properly. Thereafter, weekly interrogation shall be performed or as is appropriate to the approach employed in accordance with the monitoring plan. The sites must also be checked after every precipitation event over one inch in depth at its designated rain gage to check for possible washout or damage to the monitoring equipment. The reliability of monitoring data shall be assessed on a weekly basis for the month following commencement of monitoring. The monitoring results shall be evaluated quarterly thereafter and the findings of each evaluation shall be documented.

C. Monitoring data shall permit flow estimates to be made in units of MGD.

PART 6: MONITOR INSTALLATION

A. A field sketch of each of the selected monitoring locations will be prepared. The sketch will include a dimensioned profile section and plan view of the monitoring manhole, the adjacent upstream and downstream manholes and connecting pipes, and the equipment installation configuration. Describe any adverse hydraulic conditions. Monitoring locations will be identified on a municipal sewer GIS map.

B. Site set-up information such as measured sensor offsets, site name, manhole number, pipe size, meter number, should be provided on hard copy along with pre-installation calibration information verifying the initial calibration and calibrators name, dates of calibration and installation, and an explanation of any variance from manufacturer-recommended procedures.

C. Bench and field calibration of flow metering devices shall be performed as applicable for the monitor type and in accordance with the manufacturer's instructions, and defined in the Data Quality Assurance and Control Plan submitted by the Engineer. Calibration measurements and adjustments shall be documented and dates and time recorded on field sheets. If velocity profiling is performed, appropriate methods shall be employed for the pipe or channel of interest: the 0.9 times U-max or 0.2, 0.4, 0.8 methods will be employed for low flow conditions in smaller pipes; the 2-D method will be used for higher flows in larger pipes.

D. The Municipality and the Authority shall report within 30 days if any monitoring devices are being moved or if there are any substantive changes to meter installations or adherence to the Data Quality Assurance and Control Plan. The approved monitoring plan shall be amended and submitted to the Department within 45 days of changes.

PART 7: DATA RECORDING

A. The memory modules shall be programmed for obtaining and storing readings at 15-minute intervals at the quarter hour (i.e. 2:00, 2:15, 2:30 **not** 2:03, 2:18, 2:33). To match flow data with rainfall data, care shall be taken to ensure all clocks in all the meters are synchronized. Make assurances that no data is lost by checking the manufacturers manual to determine the maximum period of record before new data wraps over previous memory module data.

B. Flows shall be calculated and recorded in million gallons per day (MGD) **not** CFS. Data shall be formatted to three (3) decimal places (X.XXX). Levels shall be recorded in inches, and velocity will be calculated in FPS.

PART 8: METER MAINTENANCE & INTERROGATIONS

A. Each monitor will be interrogated every three days following the initial meter installation until the equipment is performing properly. The monitors shall be interrogated a week later and bi-weekly thereafter for the duration of the monitoring period. The sites must also be checked after every precipitation event over one inch in depth at its designated rain gage to check for possible washout or damage to the monitoring equipment.

B. Field data information, such as depth and velocity readings or flow–points, shall be measured every time a data interrogation is conducted and recorded on the site information sheets to verify the equipment is properly calibrated and providing reliable results. Interrogations shall be scheduled at differing times of day and weather conditions to obtain field data points over a wide range of flow depths.

C. It may be necessary to take additional velocity measurements to get a representative range of field data points to ensure proper calibration.

D. Maintenance of monitoring devices shall be performed during every interrogation. Battery charge, desiccants and vent tubes shall be checked. Sensors shall be inspected and paper, rags, oil, and/or debris shall be cleaned off the sensors in accordance with manufacturer's instructions. It may also be necessary to remove sediment and gravel when it interferes with proper operation of the monitoring devices. Ensure the sensor surfaces remain clean, in good condition and properly formed.

E. A field log of all measurements and interrogations shall be maintained as documentation and shall be available upon request by the Department.

PART 9: DATA SUBMISSION

A. Consistent file naming conventions will be adopted. Files will be named in accordance with the following format: SITE#MON.TXT, where:

- SITE = 4 character municipality ID (BALD, WMIF, WHIT, PITT, and BREN)
- # = The monitor number within a municipality (e.g. BALD3, WMIF1, PITT2, etc.)
- MON = month (APR for submission 1, MAY for submission 2, JUN for submission 3).

EXAMPLE: SITE#MON.TXT (e.g. BALD3APR.TXT, WMIF1MAY.TXT, etc.)

B. Submit comma-delineated ASCII files of the flow monitoring data in the format below. Add header lines with monitor location and column headings consistent with the following example:

BALD1MAR.TXT - Main Interceptor along Glass Run Road
MM , DD , YY , HH , MM , FLOW (MGD) , LEVEL (IN) , VEL (FT/SEC)
2 , 26 , 96 , 11 , 45 , 3.56 , 14.24 , 2.49
2 , 26 , 96 , 12 , 00 , 3.42 , 13.92 , 2.42
2 , 26 , 96 , 12 , 15 , 3.38 , 13.89 , 2.40
2 , 26 , 96 , 12 , 30 , 3.43 , 13.94 , 2.42

Excel files are also acceptable for data submission.

C. Prepare and submit superimposed flow/level/rainfall versus time plots covering one-month intervals, beginning with the first day of the month. Monthly flow, level and rainfall (vertical axis) versus time (horizontal axis) plots will be prepared for each monthly data submission.

D. Prepare and maintain other quality control documentation such as "scatter plots" (flow versus level or velocity versus level) covering the entire four-week reporting period. Consistent user-selected vertical axis scales shall be used as opposed to varying computer selected axis scales.

E. Prepare and submit the field measurement information in a consistent format.

F. Upon completion of the flow monitoring and planning tasks, prepare a summary report for Department review. Provide a summary and analysis of these aspects of the monitoring and planning effort:

- its conformance with the approved monitoring plan,
- historic QA/QC practices,
- intermunicipal monitoring efforts, and
- both submittals described in above Paragraphs C and D of this Appendix D.

Assess the utility, applicability and scope of the data and the extent to which all of the above components impact fulfilling the objectives of the monitoring effort required by Paragraph 14 of this document.

Appendix E

Semi-Annual Progress Report

Authority ____________

Watershed ____________

Revision Date ____________

Facility: CSO Municipalities

Reporting Period

From ____________ to ____________

	Task Description	Proposed Start Date	Actual Start Date	Required Completion Date	Actual Completion Date	Required Percentage of Project Completed	Actual Percentage of Project Completed	Comments
	Phase I: System Inventory/ Operation and Maintenance							
(A)	Physical survey (Year 1) Critical/SSS	June 1, 2004		May 31, 2005		33%		
	Physical survey (Year 2) Critical/SSS	June 1, 2005		May 31, 2006		66%		
	Physical survey (Year 3) Critical/SSS	June 1, 2006		May 31, 2007		100%		
	Physical survey (Year 4) Non-Critical	June 1, 2007		May 31, 2008				
	Physical survey (Year 5) Non-Critical	June 1, 2008		May 31, 2009				
	Physical survey (Year 6) Non-Critical	June 1, 2009		May 31, 2010				
	Physical survey (Year 7) Non-Critical	June 1, 2010		May 31, 2011				
	Physical survey (Year 8) Non-Critical	June 1, 2011		May 31, 2012				
	Physical survey (Year 9) Non-Critical	June 1, 2012		May 31, 2013				
	Physical survey (Year 10) Non-Critical	June 1, 2013		May 31, 2014				
(B)	Cleaning / CCTV (Year 1) Critical/SSS	June 1, 2004		May 31, 2005		16.7%		
	Cleaning / CCTV (Year 2) Critical/SSS	June 1, 2005		May 31, 2006		33.3%		
	Cleaning / CCTV (Year 3) Critical/SSS	June 1, 2006		May 31, 2007		50%		
	Cleaning / CCTV (Year 4) Critical/SSS	June 1, 2007		May 31, 2008		66.7%		
	Cleaning / CCTV (Year 5) Critical/SSS	June 1, 2008		May 31, 2009		83.3%		
	Cleaning / CCTV (Year 6) Critical/SSS	June 1, 2009		May 31, 2010		100%		
	Cleaning / CCTV (Year 1) Non-Critical	June 1, 2004		May 31, 2005				
	Cleaning / CCTV (Year 2) Non-Critical	June 1, 2005		May 31, 2006				
	Cleaning / CCTV (Year 3) Non-Critical	June 1, 2106		May 31, 2007				
	Cleaning / CCTV (Year 4) Non-Critical	June 1, 2007		May 31, 2008				
	Cleaning / CCTV (Year 5) Non-Critical	June 1, 2008		May 31, 2009				
	Cleaning / CCTV (Year 6) Non-Critical	June 1, 2009		May 31, 2010				
	Cleaning / CCTV (Year 7) Non-Critical	June 1, 2010		May 31, 2011				
	Cleaning / CCTV (Year 8) Non-Critical	June 1, 2011		May 31, 2012				

*Attach documentation of work completed during the reporting period.

Appendix E

Semi-Annual Progress Report

Authority ______________

Watershed ______________

Revision Date ______________

Facility: CSO Municipalities

Reporting Period ______________

From ______________ to ______________

Task Description	Proposed Start Date	Actual Start Date	Required Completion Date	Actual Completion Date	Required Percentage of Project Completed	Actual Percentage of Project Completed	Comments
(C) GIS Mapping (Year 1)	June 1, 2004		May 31, 2005		33%		
GIS Mapping (Year 2)	June 1, 2005		May 31, 2006		66%		
GIS Mapping (Year 3)	June 1, 2006		May 31, 2007		100%		
(D) Dye Testing (Year 1)	June 1, 2004		May 31, 2005		33%		
Dye Testing (Year 2)	June 1, 2005		May 31, 2006		66%		
Dye Testing (Year 3)	June 1, 2006		May 31, 2007		100%		
(E) Enforcement-Illegal connections	June 1, 2004		November 30, 2007		95%		
(F) Ordinance development							
(i) Prohibit Storm Water	June 1, 2004		November 1, 2004		100%		
(ii) Point of Sale Ordinance	June 1, 2004		November 1, 2004		100%		
(G) Deficiency corrections (Year 1) Critical/SSS	June 1, 2005		November 30, 2006		20%		
Deficiency corrections (Year 2) Critical/SSS	December 1, 2006		November 30, 2007		40%		
Deficiency corrections (Year 3) Critical/SSS	December 1, 2007		November 30, 2008		60%		
Deficiency corrections (Year 4) Critical/SSS	December 1, 2008		November 30, 2009		80%		
Deficiency corrections (Year 5) Critical/SSS	December 1, 2009		November 30, 2010		100%		
Deficiency corrections (Year 1) Non-Critical	December 1, 2005		November 30, 2006				
Deficiency corrections (Year 2) Non-Critical	December 1, 2006		November 30, 2007				
Deficiency corrections (Year 3) Non-Critical	December 1, 2007		November 30, 2008				
Deficiency corrections (Year 4) Non-Critical	December 1, 2008		November 30, 2009				
Deficiency corrections (Year 5) Non-Critical	December 1, 2009		November 30, 2010				
Deficiency corrections (Year 6) Non-Critical	December 1, 2010		November 30, 2011				
Deficiency corrections (Year 7) Non-Critical	December 1, 2011		May 31, 2012				

*Attach documentation of work completed during the reporting period.

Appendix E

Semi-Annual Progress Report

Authority ____________

Watershed ____________

Revision Date ____________

Facility: CSO Municipalities

Reporting Period ____________

From ____________ to ____________

Task Description	Proposed Start Date	Actual Start Date	Required Completion Date	Actual Completion Date	Required Percentage of Project Completed	Actual Percentage of Project Completed	Comments
(H) Complete system hydraulic characterization (Year 1)	June 1, 2004		May 31, 2005		25%		
Complete system hydraulic characterization (Year 2)	June 1, 2005		May 31, 2006		50%		
Complete system hydraulic characterization (Year 3)	June 1, 2006		May 31, 2007		75%		
Complete system hydraulic characterization (Year 4)	June 1, 2007		May 31, 2008		100%		
(I) Submit report of implementation of nine minimum controls			December 1, 2005				
Submit supplemental report of implementation of NMC minimum controls			December 1, 2010				
PHASE II: Planning							
Flow monitoring	June 1, 2007		May 31, 2008				

*Attach documentation of work completed during the reporting period.

Tap allocations for this year ____________ Taps issued for this report period ____________

Based on the above information, are the Municipality and the Authority in compliance with the approved schedule? ____________ (Yes/No) If no, please include an explanation.

Municipality Official: ______________________ Signature / Title ____________ Date

Authority Official: ______________________ Signature / Title ____________ Date

APPENDIX F
NPDES PERMIT

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER MANAGEMENT PROGRAM

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

NPDES PERMIT NO. PA0217611

In compliance with the provisions of the Clean Water Act, 33 U.S.C. Section 1251 et seq. (the "Act") and Pennsylvania's Clean Streams Law, as amended, 35 P.S. Section 691.1 et seq.,

City of Pittsburgh 301 City-County Building 414 Grant Street Pittsburgh, PA 15219	and	The Pittsburgh Water and Sewer Authority (PWSA) 441 Smithfield Street Pittsburgh, PA 15222

is authorized to discharge combined sewage during wet weather from overflows within its combined sewer system (CSS) located in:

City of Pittsburgh
Allegheny County

to receiving waters as identified in Part A pages 2a through 2m

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts A, B, and C hereof.

THIS PERMIT SHALL EXPIRE AT MIDNIGHT, _________________.

The authority granted by this permit is subject to the following further qualifications:

1. If there is a conflict between the application, its supporting documents and/or amendments and the terms and conditions of this permit, the terms and conditions shall apply.

2. Failure to comply with the terms, conditions, or effluent limitations of this permit is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal.

3. Complete application for renewal of this permit, or notification of intent to cease discharging by the expiration date, must be submitted to the Department at least 180 days prior to the expiration date (unless permission has been granted by the Department for submission at a later date), using the appropriate NPDES permit application form.

   In the event that a timely and complete application for renewal has been submitted and the Department is unable, through no fault of the permittee, to reissue the permit before the expiration date, the terms and conditions of this permit, including submission of the Discharge Monitoring Reports, will be automatically continued and will remain fully effective and enforceable pending the grant or denial of the application for permit renewal.

4. This NPDES permit does not constitute authorization to construct or make modifications to the combined sewer system necessary to meet the terms and conditions of this permit.

DATE PERMIT ISSUED _______________ ISSUED BY _______________________

Tim V. Dreier, P.E.
Water Management Program Manager

DATE EFFECTIVE _______________

1. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW WHICH RECEIVE WASTE FROM: combined sewer overflows, CSO

a. The permittee is authorized to discharge during the period from effective date through expiration date.

b. The outfalls listed below serve as combined sewer overflows necessitated by storm water entering the sewer system and exceeding the hydraulic capacity of the sewers and/or the treatment plant and are permitted to discharge only for such reason. The specific effluent limitations, monitoring and reporting requirements applicable to these outfalls are detailed in subsequent paragraphs of Part A. Refer also to Part C - Other Specific Requirements for Management and Control of Combined Sewer Overflows

Outfall	Name	Receiving Stream	Latitude/Longitude
015P001		Saw Mill Run	40° 24' 52"/ 80° 00' 37"
016A001		Little Saw Mill Run	40° 25' 18" / 80° 01' 50"
016A002		Little Saw Mill Run	40° 25' 23" / 80° 01' 47"
030N001		UNT of Becks Run	40° 24' 53" / 79° 57' 57"
032N001		Becks Run	40° 24' 23" / 79° 58' 47"
032P001		Becks Run	40° 24' 17" / 79° 58' 37"
034R001		Culvert to Saw Mill Run	40° 24' 30" / 80° 00' 21"
035A001		Little Saw Mill Run	40° 24' 47" / 80° 01' 53"
035E001		Little Saw Mill Run	40° 24' 37" / 80° 01' 56"
035J001		Little Saw Mill Run	40° 24' 28" / 80° 02' 00"
036R001		Little Saw Mill Run	40° 24' 21" / 80° 02' 16"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall		Receiving Stream	Latitude/Longitude
039E001		Bells Run	40° 25' 47" / 80° 04' 00"
039J001		Bells Run	40° 25' 37" / 80° 03' 51"
039K001		Bells Run	40° 25' 36" / 80° 03' 38"
060A001		UNT Saw Mill Run	40° 25' 14" / 79° 59' 48"
068H001		Bells Run	40° 25' 48" / 80° 04' 10"
068H002		Bells Run	40° 25' 47" / 80° 04' 00"
088M001		Nine Mile Run	40° 25' 01" / 79° 55' 00"
088S001		Nine Mile Run	40° 24' 56" / 79° 55' 01"
089D001		Monongahela River	40° 24' 41" / 79° 55' 12"
095E001		UNT Saw Mill Run	40° 23' 24" / 79° 59' 59"
095J001		Saw Mill Run	40° 23' 15" / 79° 59' 50"
096N001		Baldwin Borough Sewer	40° 23' 07" / 80° 01' 01"
097L001		Mt. Lebanon Township Sewer	40° 23' 19" / 80° 01' 24"
121H001		Allegheny River	40° 29' 18" / 79° 55' 09"
128P001		Nine Mile Run	40° 25' 27" / 79° 54' 31"
128R001		Nine Mile Run	40° 25' 28" / 79° 54' 28"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
128R002		Nine Mile Run	40° 25' 33" / 79° 54' 20"
129B001		Nine Mile Run	40° 25' 21" / 79° 54' 37"
134A001		Irwins Run	40° 22' 59" / 79° 55' 57"
138K001		Weymans Run	40° 22' 37" / 79° 59' 46"
139B001		UNT Saw Mill Run	40° 22' 57"/ 80° 00' 44"
139B002		UNT Saw Mill Run	40° 22' 57" / 80° 00' 42"
139B003		UNT Saw Mill Run	40° 22' 57" / 80° 00' 41"
139F001		UNT Saw Mill Run	40° 22' 55" / 80° 00' 36"
163G001		Ross Township Sewer	40° 29' 54" / 80° 00' 22"
175L001		Wilkinsburg Borough Sewer	40° 25' 41" / 79° 53' 20"
177K001		Nine Mile Run	40° 25' 39" / 79° 53' 35"
184E001		Streets Run	40° 22' 19" / 79° 54' 58"
185H001		UNT of Streets Run	40° 22' 21" / 79° 55' 04"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

The following outfalls are in the PWSA system or to which the PWSA system is satellite.

Outfall	Name	Receiving Stream	Latitude/Longitude
001FM01		Monongahela River	40° 26' 19" / 80° 00' 28"
001LM02		Monongahela River	40° 26' 16" / 80° 00' 22"
001MM03		Monongahela River	40° 26' 12" / 80° 00' 11"
001MM03A		Monongahela River	40° 26' 09" / 80° 00' 03"
001SM04		Monongahela River	40° 26' 07" / 79° 59' 58"
002NM05		Monongahela River	40° 26' 03" / 79° 59' 58"
003AM06		Monongahela River	40° 25' 52" / 80° 00' 00"
003BM07		Monongahela River	40° 25' 51" / 79° 59' 44"
003BM08		Monongahela River	40° 25' 51" / 79° 59' 38"
003CM10		Monongahela River	40° 25' 52" / 79° 59' 29"
003CM11		Monongahela River	40° 25' 52" / 79° 59' 20"
003CM11A		Monongahela River	40° 25' 54" / 79° 59' 17"
003DM12		Monongahela River	40° 25' 54" / 79° 59' 08"
003DM13		Monongahela River	40° 25' 55" / 79° 59' 01"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
007A037		Ohio River	40° 27' 08" / 80° 01' 58"
007A038		Ohio River	40° 27' 04" / 80° 01' 54"
007E039		Ohio River	40° 26' 58" / 80° 01' 47"
007K040		Ohio River	40° 26' 52" / 80° 01' 35"
007K041		Ohio River	40° 26' 53" / 80° 01' 31"
007M043		Ohio River	40° 26' 48" / 80° 01' 27"
007P014		Ohio River	40° 26' 38" / 80° 01' 38"
007P014A		Ohio River	40° 26' 38" / 80° 01' 39"
007P014B		Ohio River	40° 26'39" / 80° 01' 42"
008LA47		Allegheny River	40° 26' 44" / 80° 00' 26"
008LA48		Allegheny River	40° 26' 45" / 80° 00' 20"
008MA49		Allegheny River	40° 26' 47" / 80° 00' 13"
008MA50		Allegheny River	40° 26' 49" / 80° 00' 08"
008MA51		Allegheny River	40° 26' 50" / 80° 00' 02"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
008PA01		Allegheny River	40° 26' 34" / 80° 00' 29"
008RA02		Allegheny River	40° 26' 36" / 80° 00' 25"
008RA03		Allegheny River	40° 26' 36" / 80° 00' 21"
008RA04		Allegheny River	40° 26' 37" / 80° 00' 18"
008RA04A		Allegheny River	40° 26' 38" / 80° 00' 18"
008RA05		Allegheny River	40° 26' 38" / 80° 00' 14"
008RA06		Allegheny River	40° 26' 38" / 80°00' 12"
008SA07		Allegheny River	40° 26' 40" / 80° 00' 07"
008SA08		Allegheny River	40° 26' 40" / 80° 00' 06"
008SA09		Allegheny River	40° 26' 41" / 80° 00' 04"
008SA10		Allegheny River	40° 26' 42" / 80°00' 01"
009BA59		Allegheny River	40° 27' 03" / 79° 59' 37"
009BA59A		Allegheny River	40° 27' 08" / 79° 59' 30"
009CA16		Allegheny River	40° 27' 05" / 79° 59' 18"
009EA56		Allegheny River	40° 26' 55" / 79° 59' 52"
009EA58		Allegheny River	40° 26' 58" / 79° 59' 43"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
009FA14A		Allegheny River	40° 26' 54" / 79° 59' 35"
009FA15		Allegheny River	40° 26' 56" / 79° 59' 31"
009JA11		Allegheny River	40° 26' 43" / 79° 59' 57"
009JA12		Allegheny River	40° 26' 44" / 79° 59' 54"
009JA13		Allegheny River	40° 26' 46" / 79° 59' 48"
009JA13A		Allegheny River	40° 26' 50" / 79° 59' 43"
009KA14		Allegheny River	40° 26' 51" / 79° 59' 40"
011RM19		Monongahela River	40° 26' 03" / 79° 58' 23"
011SM19B		Monongahela River	40° 26' 00" / 79° 58' 07"
012AM14		Monongahela River	40° 25' 55" / 79° 58' 55"
012AM14A		Monongahela River	40° 25' 56" / 79° 58' 50"
012AM15		Monongahela River	40° 25' 56" / 79° 58' 44"
012BM16		Monongahela River	40° 25' 56" / 79° 58' 38"
012BM17		Monongahela River	40° 25' 56" / 79° 58' 34"
012CM18		Monongahela River	40° 25' 55" / 79° 58' 28"
012CM20		Monongahela River	40° 25' 53" / 79° 58' 22"
012DM21		Monongahela River	40° 25' 51" / 79° 58' 14"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
012DM22		Monongahela River	40° 25' 49" / 79° 58' 07"
012HM23		Monongahela River	40° 25' 48" / 79° 58' 02"
021AO10		Ohio River	40° 27' 37" / 80° 02' 53"
021DO30		Ohio River	40° 27' 40" / 80° 02' 09"
021HO31		Ohio River	40° 27' 33" / 80° 02' 06"
021HO32		Ohio River	40° 27' 30" / 80° 02' 05"
021KO11		Ohio River	40° 27' 22" / 80° 02' 34"
021MO33		Ohio River	40° 27' 26" / 80° 02' 04"
021MO34		Ohio River	40° 27' 22" / 80° 02' 04"
021RO13		Ohio River	40° 27' 14" / 80° 02' 24"
021SO35		Ohio River	40° 27' 15" / 80° 02' 03"
021SO36		Ohio River	40° 27' 12" / 80° 02' 01"
024LA61		Allegheny River	40° 27' 21" / 79° 59' 01"
024MA18		Allegheny River	40° 27' 18" / 79° 58' 59"
024RA60		Allegheny River	40° 27' 13" / 79° 59' 24"
024SA17		Allegheny River	40° 27' 10" / 79° 59' 11"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
024SA17A		Allegheny River	40° 27' 16" / 79° 59' 04"
024SA17B		Allegheny River	40° 27' 18" / 79° 59' 01"
025AA62		Allegheny River	40° 27' 36" / 79° 58' 56"
025BA19B		Allegheny River	40° 27' 37" / 79° 58' 34"
025BA20		Allegheny River	40° 27' 39" / 79° 58' 33"
025EA19		Allegheny River	40° 27' 27" / 79° 58' 46"
025FA19A		Allegheny River	40° 27' 33" / 79° 58' 39"
025JA18A		Allegheny River	40° 27' 22" / 79° 58' 55"
025JA18B		Allegheny River	40° 27' 25" / 79° 58' 50"
029FM19A		Monongahela River	40° 25' 49" / 79° 57' 41"
029KM26		Monongahela River	40° 25' 36" / 79° 57' 41"
029PM27		Monongahela River	40° 25' 26" / 79° 57' 30"
029RM29		Monongahela River	40° 25' 28" / 79° 57' 11"
030MM31		Monongahela River	40° 25' 08" / 79° 56' 56"
030MM31A		Monongahela River	40° 25' 08" / 79° 56' 56"
031DM32		Monongahela River	40° 24' 47" / 79° 57' 06"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
031GM34		Monongahela River	40° 24' 40" / 79° 57' 17"
031HM33		Monongahela River	40° 24' 40" / 79° 57' 05"
031HM35		Monongahela River	40° 24' 34" / 79° 57' 04"
031MM36		Monongahela River	40° 24' 25" / 79° 57' 02"
042DO09		Ohio River	40° 27' 42" / 80° 03' 00"
043PC07		Chartiers Creek	40° 27' 42" / 80° 03' 39"
043RC03		Chartiers Creek	40° 27' 42" / 80° 03' 14"
043RC05		Chartiers Creek	40° 27' 43" / 80° 03' 22"
043SC02		Chartiers Creek	40° 27' 52" / 80° 03' 12"
043SO08		Ohio River	40° 27' 46" / 80° 03' 05"
044BO27		Ohio River	40° 28' 19" / 80° 02' 36"
044RO29		Ohio River	40° 28' 47" / 80° 02' 14"
048DA26		Allegheny River	40° 28' 08" / 79° 58' 02"
048DA27		Allegheny River	40° 28' 17" / 79° 57' 58"
048FA65		Allegheny River	40° 28' 03" / 79° 58' 37"
048FA66		Allegheny River	40° 28' 09" / 79° 58' 24"
048GA25		Allegheny River	40° 28' 00" / 79° 58' 10"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
048LA23		Allegheny River	40° 27' 50" / 79° 58' 19"
048NA63		Allegheny River	40° 27' 48" / 79° 58' 48"
048NA64		Allegheny River	40° 27' 52" / 79° 58' 45"
048PA21		Allegheny River	40° 27' 43" / 79° 58' 28"
048RA22		Allegheny River	40° 27' 47" / 79° 58' 23"
057AM37		Monongahela River	40° 24' 15" / 79° 56' 57"
057KM38		Monongahela River	40° 23' 56" / 79° 56' 36"
057KM39		Monongahela River	40° 23' 54" / 79° 56' 30"
057MM40		Monongahela River	40° 23' 55" / 79° 56' 11"
061DS23		Saw Mill Run	40° 25' 08" / 79° 59' 56"
061DS24		Saw Mill Run	40° 24' 30" / 80° 00' 07"
067FC26A		Chartiers Creek	40° 25' 14" / 80° 04' 30"
067FC27		Chartiers Creek	40° 25' 07" / 80° 04' 31"
067KC28		Chartiers Creek	40° 25' 04" / 80° 04' 32"
067KC29		Chartiers Creek	40° 25' 01" / 80° 04' 35"
069EC19		Chartiers Creek	40° 26' 24" / 80° 04' 53"
071CC11		Chartiers Creek	40° 27' 37" / 80° 04' 13"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
071CC12		Chartiers Creek	40° 27' 40" / 80° 04' 23"
072RC13A		Chartiers Creek	40° 27' 47" / 80° 04' 29"
075A026		Ohio River	40° 28' 46" / 80° 02' 49"
075A026A		Ohio River	40° 28' 28" / 80° 02' 00"
080BA30		Allegheny River	40° 28' 50" / 79° 57' 34"
080EA29		Allegheny River	40° 28' 42" / 79° 57' 42"
080BA29A		Allegheny River	40° 28' 47" / 79° 57' 35"
080NA28		Allegheny River	40° 28' 24" / 79° 57' 53"
104HC24		Chartiers Creek	40° 25' 15" / 80° 04' 58"
104HC25		Chartiers Creek	40° 25' 14" / 80° 04' 57"
107GC14		Chartiers Creek	40° 26' 57" / 80° 05' 21"
107SC15		Chartiers Creek	40° 26' 40" / 80° 05' 09"
108HC13A		Chartiers Creek	40° 27' 34" / 80° 05' 19"
119MA33		Allegheny River	40° 29' 05" / 79° 57' 14"
119MA34		Allegheny River	40° 29' 07" / 79° 57' 09"
119RA31		Allegheny River	40° 28' 57" / 79° 57' 27"
119RA32		Allegheny River	40° 29' 01" / 79° 57' 21"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

1b. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR THE OUTFALLS LISTED BELOW (CONTINUED):

Outfall	Name	Receiving Stream	Latitude/Longitude
120CA36		Allegheny River	40° 29' 22" / 79° 56' 17"
120DA37		Allegheny River	40° 29' 24" / 79° 56' 09"
120DA37A		Allegheny River	40° 27' 56" / 79° 55' 58"
120EA35		Allegheny River	40° 29' 12" / 79° 56' 54"
121AA38		Allegheny River	40° 29' 24" / 79° 55' 50"
121CA40		Allegheny River	40° 29' 20" / 79° 55' 24"
121HA41		Allegheny River	40° 29' 16" / 79° 55' 08"
122EA42		Allegheny River	40° 28' 56" / 79° 54' 31"
129NM47		Nine Mile Run	40° 24' 57" / 79° 54' 57"
009E001		Allegheny River	40° 26' 58" / 79° 59' 44"

Monitoring in compliance with the requirements specified above shall be performed at the discharge pipe of each combined sewer overflow.

PART A

2. EFFLUENT LIMITATIONS

This permit establishes effluent limitations in the form of nine minimum technology-based controls (NMCs), and a schedule of milestones for submission of a long term CSO control plan (LTCP) specified by the EPA National CSO Policy and approved State CSO strategies. The NMCs influence the rate, quality and quantity of pollutants discharged from combined sewer overflow(s) into surface waters of the Commonwealth. Part C of this permit specifies the wet weather CSO permitting requirements that must be met by the permittee. Detailed guidance documents related to the NMCs and the LTCP may be obtained from the Environmental Protection Agency (EPA).

In addition, all discharges from combined sewer overflows must comply with any applicable effluent limitations established in 25 Pa. Code Chapters 91-96, 102, and 105 of the Department's Rules and Regulations. For all combined sewer overflows covered under this permit, the Department may, upon written notice, require additional best management practices (BMPs) or other control measures, including compliance with a numeric water-quality based effluent limitation to ensure that the water quality standards of the receiving water are attained.

3. TOXICITY TESTING

The Department may require the permittee to conduct acute whole effluent toxicity testing (WETT) on one or more overflows in accordance with the Department's WETT protocols. The Department will provide such protocols with any notice to conduct the testing.

4. MONITORING AND RECORD KEEPING

a. Monitoring

In compliance with the reporting requirements of the "Annual CSO Status Report" set forth in Part C(1)(c)(2)(i), flow monitoring shall be conducted as necessary to quantify wet weather related overflow occurrences (frequencies, volumes, and durations) at each permitted combined sewer outfall set forth in Part A. These occurrences must be quantified either by direct measurement (collected flow monitor data) or as predicted by collection system models in simulating the collection system hydraulic response to rainfall events recorded within the service area during the reporting year. In situations where flow monitoring has been previously conducted to quantify overflow occurrences at a specific combined sewer outfall but hydraulic models are under development but not yet available to facilitate reporting requirements, the permittee, during this interim condition, shall provide an assessment of the likely overflow frequency, volume and duration for the outfall based upon the prior rainfall and overflow data. In any case, however, monitoring may or may not be required where prior experience or previous data collection efforts indicate that wet weather overflows do not occur. The basis for this determination will be documented in the "Annual CSO Status Report."

PART A

Also, all directly measured overflow data shall be summarized on the attached special CSO Discharge Monitoring Report ("DMR") and shall be recorded in the format specified in Part A(4)(b). The DMR shall be kept on file at the permittee's business office in accordance with Part A(4)(c)(i) below for inspection by the Department or other interested persons, and shall be submitted to the Department with the "Annual CSO Status Report" required under Part C(1)(c)(2)(i), or earlier upon request.

In addition, a regular program of inspection and maintenance shall be undertaken at flow regulating structures to minimize debris and other obstructions that may contribute to overflow occurrences. At a minimum, inspections shall occur once per week. Any dry-weather overflow occurrences shall be reported in compliance with Part C, Condition 1C(2)ii)(c). However, whenever a rainfall event of 0.25 inches per hour in intensity (measured instantaneously) has occurred, all flow regulating structures shall be inspected within two working days following the day of this measurement. These wet weather-related inspections shall also fulfill the dry-weather inspection requirement for that week.

b. Recording of Results

For each measurement or inspection conducted pursuant to the requirements of this permit, the permittee shall record the following information:

(1) The exact place, date, and time of measurements and/or inspections.

(2) The person(s) who performed the measurements and/or inspections.

(3) The analytical techniques or methods used

(4) The summary of results of the analysis/inspection

(5) The date(s) analyses/inspections were performed

(6) The individual who performed the analysis/inspection

c. Records Retention

(i) All records of monitoring activities and results (including, where applicable, all original strip chart recordings for continuous monitoring instrumentation and calibration and maintenance records), copies of all reports required by this permit, any authorizations received from the Department and records of all data used to complete the application for this permit, DMRs and Annual CSO Status Report shall be retained by the permittee until completion of the Long Term Control Plan.

(ii) In addition to the requirements in Part A(4)(c)(i) above, permittees are required to retain analysis results for any samples collected. Permittees must submit such monitoring results to the Department upon request. A summary of such results shall also be included as part of the Annual CSO Status Report required under Part C(2) and every five years with the permit renewal application.

5. REPORTING

a. Reporting of Monitoring Results

Monitoring results shall be reported on a Discharge Monitoring Report (DMR) Form. A signed copy of the DMR Form and all other reports required herein shall be kept on file at the permittee's business office and shall be submitted with the Annual CSO Status Report to each of the following:

Department of Environmental Protection
Water Management
400 Waterfront Drive
Pittsburgh, PA 15222-4745

Allegheny County Health Department
Frank B. Clack Health Center Bldg. 5
Water Pollution Control Program
40th Street and Penn Avenue
Pittsburgh, PA 15224

Ohio River Valley Sanitation Commission
5735 Kellogg Avenue
Cincinnati, OH 45228-1112

b. Non-Compliance Reporting

(1) Required Reporting - The permittee shall report incident(s) that may cause, contribute, pose and/or have potential to cause a substantial present or future hazard to human health, adverse impact(s) to the environment and/or non-compliance to the Department in accordance with the following:

(a) 24-Hour Oral Reporting - The permittee shall give at least a 24 hour advanced notice to the Department and the ACHD of any planned changes to the permitted activity or facility that may result in present or future hazard to human health and/or damage(s) to the environment. The permittee shall also report non-compliance with any term or condition of this permit, and any statute, rule, or regulation, to the Department within 24 hours of becoming aware of the non-compliance.

(b) Follow-up Written Reporting - Where the permittee orally reports the information in Part A(5)(b)(1) within the 24-hour time period, a written submission outlining the reported information must be completed, kept on file, summarized annually and submitted to the Department and the ACHD with the Annual CSO Status Report.

(c) Non-compliance reporting pursuant to Part A(5)(b) shall not excuse a person from immediate notification to the Department of incidents causing or threatening pollution pursuant to 25 Pa. Code §91.33(a) of the Department's Rules and Regulations.

(2) Required Information - The reports and notifications required in Part A(5)(b)(1) above shall contain the following information:

(a) A description of the discharge and cause of hazard to human health and/or damage to the environment, including exact dates and times and/or the anticipated time when the discharge will be ceased;

(b) The period of non-compliance, including exact dates and times and/or the anticipated time when the discharge will return to compliance; and

(c) Steps being taken to reduce, eliminate, and prevent recurrence of incidence causing hazard to human health, adverse impact to the environment and/or the non-complying discharge.

c. Test Procedures

Any monitoring must be conducted according to test procedures approved under 40 C.F.R. Part 136, unless other test procedures have been specified in this permit or have been approved by the Department in writing.

d. Signatory Requirements

All permit applications, reports, certifications or information either submitted to the Department or that this permit requires be maintained by the permittee, shall be signed.

(1) All permit applications shall be signed as follows: For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this part, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency, or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

(2) All reports required by the permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person.

A person is a duly authorized representative only if:

(a) The authorization is made in writing by a person described above and submitted to the Department with the reports.

(b) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

(3) Changes in Signatory Authorization

If an authorization is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part A(5)(d) must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

6. RESPONSIBILITIES

a. Duty to Comply

The permittee must comply with all terms and conditions of the permit. Any permit non-compliance constitutes a violation of the Pennsylvania Clean Streams Law and the federal Clean Water Act (CWA) and constitutes grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit or permit renewal.

b. Penalties for Violations of Permit Conditions

The permittee may be subject to criminal and/or civil penalties for violations of the terms and conditions of this General Permit under Section 602 and 605 of the Clean Streams Law, 35 P.S. Sections 691.602 and 691.605, and under the Clean Water Act as specified in 40 CFR Sections 122.41(a)(2) and (3), which are incorporated by reference.

c. Need to Halt or Reduce Activity Not a Defense

The permittee may not use as a defense in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of this permit.

d. Penalties and Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance pursuant to Section 309 of the Clean Water Act (33 U.S.C. § 1319) or Sections 602 or 605 of the Clean Streams Law (35 P.S. §§ 691.602 or 691.605).

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the CWA (33 U.S.C. §1321) or Section 106 of CERCLA.

e. Other Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

f. Penalties for Falsification of Reports

Section 309(c)(4) of the Clean Water Act provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or both. In addition, criminal sanctions are set forth for false swearing and unsworn falsification at 18 Pa. C.S. §§4903-4904.

g. Penalties for Falsification of Monitoring Systems

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by fines and imprisonment described in Section 309 of the Clean Water Act. In addition, criminal sanctions are set forth for false swearing and unsworn falsification at 18 Pa. C.S. §§4903-4904.

h. Monitoring and Records

Any samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

i. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall submit a timely and administratively complete request for renewal of coverage at least 180 days prior to the expiration date specified in this permit, unless permission is granted by the Department to submit at a later date.

7. DEFINITIONS

"Best Management Practices (BMPs)"

Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce pollution to the waters of the Commonwealth. BMPs include Preparedness, Prevention and Contingency (PPC) Plans, Erosion and Sedimentation Control Plans, Storm Water Management Act Plans, and other treatment requirements, operating procedures, and practices to control sewer overflows, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

"Bypass"

The intentional diversion of waste streams from any portion of a treatment facility as defined in 40 CFR 122.41(m).

"Combined Sewer Overflow (CSO)"

Any intermittent overflow or other untreated discharge from a Municipal Combined Sewer System (including domestic, industrial and commercial wastewater and storm water) prior to reaching the headworks of the sewage treatment facility which results from a flow in excess of the dry weather carrying capacity of the system.

"Combined Sewer System (CSS)"

A sewer system or part thereof which was designed, built and operated to carry both sanitary sewage and storm water.

PART A

"Department"

The Department of Environmental Protection (DEP) of the Commonwealth.

"Dry Weather Flows"

Flows in a combined sewer system that result solely from domestic sewage, normal ground water infiltration and industrial wastewaters.

"Federal Act"

The Federal Water Pollution Control Act, Act of June 30, 1948 (Ch. 758, 62 Stat. 1155)

"Grab Sample"

A single "dip and take" sample collected at a representative point in the discharge stream.

"Infiltration"

Water other than wastewater that enters a wastewater system and building sewers from the ground through such means as defective pipes, pipe joints, connections, or manholes. (Infiltration does not include inflow.)

"Infiltration/Inflow (I/I)"

The total quantity of water from both infiltration and inflow.

"Inflow"

Water that enters a wastewater system and building sewer from sources such as roof leaders, cellar drains, yard drains, area drains, foundation drains, drains from springs and swampy areas, manhole covers, cross connection between storm drains and sanitary sewers, catch basins, cooling towers, storm waters, surface runoff, street wash waters, or drainage. (Inflow does not include infiltration.)

"Municipality"

Any county, city, borough, town, township, school district, institution or any authority created by one or more of the foregoing.

"Outfall"

The point where wastewater or drainage discharges from a sewer pipe, ditch, or other conveyance to a receiving body of water.

PART A

"Person"

Any individual, public or private corporation, partnership, association, municipality or political subdivision of this Commonwealth, institution, authority, firm, trust, estate, receiver, guardian, personal representative, successor, joint venture, joint stock company, fiduciary; Department, agency or instrumentality of State, Federal or local government, or an agent or employee thereof; or any other legal entity.

"Point Source"

Any discernible, confined, and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, or vessel or other floating craft, from which pollutants are or may be discharged.

"Publicly Owned Treatment Works (POTWs)"

Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature which is owned by a "State" or "Municipality" or "Authority".

"Rainfall Duration"

The length of time of a rainfall event.

"Rainfall Intensity"

The amount of rainfall occurring in a unit of time, usually expressed in inches per hour.

"Satellite Combined Sewer System"

A CSS that is not also the owner/operators of the POTW into which the CSS directly flows.

"Storm Water"

Runoff from precipitation, snow melt runoff, and surface runoff and drainage.

"Surface Waters of the Commonwealth"

Perennial and intermittent streams, rivers, lakes, reservoirs, ponds, wetlands, springs, natural seeps and estuaries, excluding water at facilities approved for wastewater treatment such as wastewater treatment impoundments, cooling water ponds and constructed wetlands used as part of a wastewater treatment process.

"Waste Treatment Plant"

Publicly Owned Treatment Works (POTWs) or any other sewage sludge or waste water treatment devices or systems, regardless of ownership, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated for the disposal of sewage sludge. This definition does not include septic tanks or similar on-lot sewage treatment devices.

"Wet Weather Flow"

Any flow resulting from precipitation (rain, snow, etc.) which may introduce additional flow and/or contaminants into combined sewerage or sanitary sewerage systems.

PART B

STANDARD CONDITIONS

1. MANAGEMENT REQUIREMENTS

a. Permit Modification, Termination, or Revocation and Reissuance

(1) This permit may be modified, suspended, revoked, reissued or terminated in whole or in part during its term as specified in 25 Pa. Code Chapter 92.51(2).

(2) The filing of a request by the permittee for a permit or coverage modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated non-compliance, does not stay any permit condition.

(3) Toxic Pollutants

Not withstanding the above, if a toxic effluent standard or prohibition, (including any schedule of compliance specified in such effluent standard or prohibition, is established under Section 307(a) of the Act (33 U.S.C.§1317(a)) for a toxic pollutant that is present in the discharge, and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, then this permit shall be modified or revoked and reissued by the Department to conform with the toxic effluent standard or prohibition and the permittee will be so notified.

In the absence of a Departmental action to modify or to revoke and reissue this permit, any toxic effluent standard or prohibition established under Section 307(a) of the Act (33 U.S.C. § 1317(a)) is considered to be effective and enforceable against the permittee.

(4) Permit modification or revocation will be conducted according to 25 Pa. Code Chapter 92 of the Department's Rules and Regulations.

b. Duty to Provide Information

(1) The permittee shall furnish to the Department, within a reasonable time, any information that the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or coverage approved under this permit, or to determine compliance with this permit.

(2) The permittee shall furnish to the Department, upon request, copies of records required to be kept by this permit.

(3) Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information to the Department.

(4) The permittee shall give advance notice to the Department of any planned physical alterations or additions to the permitted facility which could in any way affect the quantity and/or quality of the combined sewer overflow(s) from the facility.

c. Facilities Operation

The permittee shall at all times maintain in good working order and properly operate all facilities and systems (and related appurtenances) which are installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes effective performance based on designed facility removals, adequate funding, effective management, adequate operator staffing and training, and adequate laboratory and processing controls including appropriate quality assurance procedures. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with this permit.

d. Adverse Impact

The permittee shall take all reasonable steps to minimize or prevent any adverse impact on the environment or human health resulting from non-compliance with this permit.

e. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed in accordance with the Solid Waste Management Act (35 P.S. §§ 6018.101 - 6018.1003), 25 Pa. Code Chapters 271, 273, 275, 283, 285 and 287-291, and in a manner such as to prevent any pollutant from such materials from adversely affecting the environment.

PART B

2. RESPONSIBILITIES

a. Right of Entry

(1) Pursuant to Sections 5(b) and 305 of Pennsylvania's Clean Streams Law and 25 Pa. Code, Chapter 92, the permittee shall allow the head of the Department, the EPA Regional Administrator, and/or their authorized representatives, upon the presentation of credentials and other documents as may be required by law:

(a) To enter upon the permittee's premises where an effluent source is located or where records must be kept under the terms and conditions of this permit;

(b) At reasonable times, to have access to and copy any records required to be kept under the terms and conditions of this permit;

(c) To inspect at reasonable times any facilities, equipment (including monitoring and control equipment) practices or operations regulated or required by this permit;

(d) To sample or monitor at reasonable times any substances or parameters at any location.

(2) The Department reserves the right to enter onto or into the facility to conduct, or to require additional monitoring controls and/or treatment where necessary in appropriate circumstances, such as where a danger of water pollution is suspected to be occurring from the CSO, or is present from the CSO.

b. Transfer of Ownership or Control

(1) No approval to discharge under this permit may be transferred unless the transfer is approved by the Department

(2) In the event of any pending change in control or ownership of facilities from which the authorized discharges emanate, the permittee shall notify the Department by letter of such pending change at least 30 days prior to the change in ownership or control.

(3) The letter shall be accompanied by the "Application for the Transfer of a Water Quality Management Permit, Part I (NPDES) and Part II", along with a written agreement between the existing permittee and the new owner or controller stating that the existing permittee shall be liable for violations of the permit up to and until the date of coverage transfer and that the new owner or controller shall be liable for permit violations from that date on.

(4) After receipt of the documentation described above, the Department shall notify the existing permittee and the new owner or controller of its decision concerning approval of the transfer.

c. Confidentiality of Reports

Except for data determined to be confidential under § 607 of the Clean Stream Law, or 25 Pa. Code, Chapter 92, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department and the EPA Regional Administrator. Effluent data shall not be considered confidential.

d. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights.

e. Severability

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstances is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

PART C

OTHER SPECIFIC REQUIREMENTS

1. MANAGEMENT AND CONTROL OF COMBINED SEWER OVERFLOWS

Combined sewer overflows (CSOs) are allowed to discharge only in compliance with this permit when flows in combined sewer systems exceed the conveyance or treatment capacities of the system during or immediately after wet weather periods. Overflows that occur without an accompanying precipitation event or snowmelt are termed "dry weather overflows" and are prohibited. CSOs are point source discharges that must be provided with control measures in accordance with the Federal Clean Water Act, Section 402Q, and the 1994 National CSO Policy.

Unless otherwise authorized under Part B of this permit, any discharge from any point other than a permitted treatment outfall or permitted combined sewer system outfall is prohibited. See e.g. Section 301(b)(1)(B) and (C) of the Clean Water Act; 40 CFR 122.44 and 133.102 (relating to limitations, standards and permit conditions; and secondary treatment). In the event there is a prohibited discharge from a sewer conveyance system, report every such discharge to the Department within 24 hours of the discharge and as an attachment to your monthly CSO Discharge Monitoring Report (CSO DMR). Indicate the date of discharge, action taken and volume of discharge 40 CFR 122.41(1)(6) and (7) (relating to reporting requirements).

The point source discharge locations (outfalls) identified on page(s) 2a through 2m of 16 under Part A of this permit serve as known combined sewer overflow locations on the permittee sewer system.

A. CONTINUED IMPLEMENTATION OF TECHNOLOGY-BASED NINE MINIMUM CONTROLS

Upon issuance of this permit, the permittee shall continue the implementation of the NMCs, demonstrate system wide compliance with the NMCs and submit discharge monitoring reports and annual reports to the Department with appropriate documentation. The permittee can at any time request to submit a modified or revised NMC report, plan or schedule to the Department for review and approval. The permittee's NMC documentation report is incorporated in this permit.

The Department will use the EPA guidance document entitled "Guidance For Nine Minimum Controls" (EPA 832-B-95-003), dated May 1995, and specific comments provided during review of the NMC documentation reports to determine continued compliance with the CSO permit requirements.

B. IMPLEMENTATION OF WATER QUALITY-BASED LONG TERM CONTROL PLAN (LTCP)

The long term goal of the LTCP requirements in this permit is to achieve compliance with the state water quality standards upon completion of the LTCP implementation. Until completion of implementation, the CSO discharge(s) shall comply with the performance standards of the selected CSO controls, when installed, and shall comply with the water quality standards found in Chapter 93, Section 93.6(b). When sufficient CSO-related information and data are available to develop water quality-based effluent limitations, the permit should be revised, as appropriate, to reflect the new effluent limitations.

Upon issuance of this permit, the permittee shall develop and submit to the Department and the ACHD a LTCP in accordance with the schedule outlined in Section F.

Upon Approval of the LTCP by the Department, the permittee shall begin implementation of its approved long term control plan (LTCP). The LTCP, at a minimum, shall incorporate the following requirements:

1. Continued implementation of the nine minimum controls;
2. Protection of sensitive areas (recreation areas, public water supply, unique ecological habitat, etc.);
3. Public participation in developing the LTCP and implementation.
4. Characterization, monitoring and modeling of overflows and assessment of water quality impacts;
5. Evaluation and selection of control alternative - presumptive or demonstrative approach;
6. Implementation schedule and financing plan for selected control options;
7. Maximizing treatment at the existing POTW treatment plant;
8. Post-construction monitoring program plan; and,
9. CSO System Operational Plan.

The LTCP is described in the EPA's guidance document entitled "Guidance For Long Term Control Plan" (EPA 832-B-95-002), dated September 1995. Using a compliance monitoring program, the permittee shall periodically review the effectiveness of the LTCP and propose any changes or revisions to the LTCP to the Department for review and approval before its implementation.

The permittee shall implement, inspect, monitor and effectively operate and maintain the CSO controls identified in the approved LTCP. The interim implementation schedule for the short term controls shall be in accordance with the approved LTCP. The final implementation of the LTCP is expected to exceed the life of the current five year permit and shall be consistent with the approved LTCP or where applicable a CO&A or other enforcement mechanism.

C. MONITORING AND REPORTING REQUIREMENTS

1. Discharge Monitoring Report for Combined Sewer Overflows (DMR for CSOs)

The permittee shall record data on CSO discharges in the format specified in the Department's DMR for CSOs attached to this permit. The data shall be submitted to the Pittsburgh Regional Office of the Department and the ACHD 28 days following a month in which one or more CSO discharges occurred. For CSOs that are part of a permitted POTW, the DMR for CSOs must be submitted with the Permittee's regular DMR. Copies of DMRs for CSOs must be retained by the permittee for at least five (5) years.

2. Annual CSO Status Report

On March 31 of each year, an Annual CSO Status Report shall be submitted to the Department and the ACHD with the annual "Municipal Wasteload Management Report" required by 25 Pa. Code Chapter 94, Section 94.12. A copy of the annual report shall also be submitted to the Ohio River Valley Sanitation Commission (ORSANCO), 5735 Kellogg Avenue, Cincinnati, OH 45228-1112. For a satellite CSO system, a copy of the annual report shall also be provided to the Allegheny County Sanitary Authority (ALCOSAN) providing treatment for its wastewater.

i. The Annual CSO Status Report shall:

a. Provide a summary of the frequency, duration and volume of the CSO discharges for the past calendar year;

b. Provide the operational status of overflow points;

c. Provide an identification of known in-stream water quality impacts, their causes, and their effects on downstream water uses;

d. Summarize all actions taken to implement the NMCs and the LTCP and their effectiveness; and

e. Evaluate and provide a progress report on implementing and necessary revisions to the NMC and LTCP.

ii. Specifically, the following CSO-related information shall be included in the report:

a. Rain gauge data - total inches (to the nearest 0.01 inch) that caused each CSO discharge being reported in the supplemental DMR for CSOs.

b. Inspections and maintenance

- Total number of outfall and regulator inspections conducted during the period of the report (reported by drainage system).

- A list of blockages (if any) corrected or other interceptor maintenance performed, including location, date and time discovered, date and time corrected, and any discharges to the stream observed and/or suspected to have occurred.

c. Dry weather overflows

Dry weather CSO discharges are prohibited. Immediate telephone notification to DEP and the ACHD of such discharges is required in accordance with 25 Pa. Code, Section 91.33. Indicate location, date and time discovered, date and time corrected/ceased, and action(s) taken to prevent their reoccurrence. A plan to correct this condition and schedule to implement the plan must be submitted with the DMR for CSOs.

d. Wet weather overflows

- For all locations that have automatic level monitoring of the regulators, report all exceedances of the overflow level during the period of the report, including location, date, time, and duration of wet weather overflows.

- For all locations at which flows in the interceptors can be controlled by throttling and/or pumping, report all instances when the overflow level was reached or the gates were lowered. For each instance, provide the location, date, time, and duration of the overflow.

D. AREA-WIDE PLANNING/PARTICIPATION REQUIREMENT

Where applicable, the permittee shall cooperate with and participate in any interconnected CSO system's NMCs and LTCP activities being developed and/or carried out by the operator(s) of these systems, and shall participate in implementing applicable portions of the approved NMC and LTCP for these systems.

The permittee shall participate in any area-wide CSO Nine Minimum technology-based Controls (NMCs) and Long Term Control Plan (LTCP) being developed by the Allegheny County Sanitary Authority (ALCOSAN), the operator of the treatment plant, and shall participate in implementing the recommendations of such area-wide LTCP.

In addition, the permittee shall in conjunction with ALCOSAN delineate their separate and joint responsibilities relative to CSOs in the system, operation and maintenance of the CSO structures, and implementation of the NMCs and LTCP. Written confirmation of this delineation shall be submitted to the Department and the ACHD not later than eighteen (18) months from the effective date of this permit.

E. PERMIT REOPENER CLAUSE

The Department reserves the right to modify, revoke and reissue this permit as provided pursuant to 40 CFR 122.62 and 124.5 for the reasons set forth in 25 Pa. Code Section 92.51(2) and for the following reasons:

1. To include new or revised conditions developed to comply with any State or Federal law or regulation that addresses CSOs and that is adopted or promulgated subsequent to the effective date of this permit.

2. To include new or revised conditions if new information indicates that CSO controls imposed under the permit have failed to ensure the attainment of State Water Quality Standards.

3. To include new or revised conditions based on new information resulting from implementation of the LTCP or other plans or data.

F. COMBINED SEWER OVERFLOW COMPLIANCE SCHEDULE

The permittee shall complete the above CSO activities in accordance with the following compliance schedule:

APPENDIX G - CREDIT FOR PRIOR WORK FORM

CREDIT FOR PRIOR WORK FORM

COA Program Task	System Description	Protocol Compliant Prior Work	Program Scope for Remaining Work
Physical survey/visual inspection: Structure physical inspection	Number of structures: Total less New * = Remainder ____ – ____ = ____	Total number of credited structures: ________	Remaining number of structures to be inspected: ________
CCTV internal inspection	Length of public sewers in linear feet: Total less New * = Remainder ____ – ____ = ____	Total length of public sewer segments with protocol compliant CCTV inspection:	Length of segments needing CCTV inspection in linear feet:
Sewer system mapping	Length of public sewers in linear feet: Total less New * = Remainder ____ – ____ = ____	Completed mapping in linear feet:	Remaining mapping in linear feet to be compliant with protocols:
Sewer system mapping: Structure location survey	Number of structures: Total less New * = Remainder ____ – ____ = ____	Total number of credited structures: ________	Remaining number of structures to be surveyed: ________

* "New" means new construction that meets the applicable requirements of this Consent Order and Agreement

Total minus new equals the remainder of the system that is subject to the requirements of this Consent Order and Agreement

NEW BUSINESS
Resolution No. 154 of 2003

Providing for Consent Order and Agreement with
The City of Pittsburgh, Commonwealth of Pennsylvania,
Department of Environmental Protection and
the Allegheny County Health Department
for
Resolution of Wet Weather Sewage Issues.

WHEREAS, The Pittsburgh Water and Sewer Authority ("Authority") and the City of Pittsburgh, the Commonwealth of Pennsylvania, Department of Environmental Protection and the Allegheny County Health Department have a mutual interest in the resolution of wet weather sewage issues.

WHEREAS, the Consent Order and Agreement meets the requirements of the "Authority" and the objectives desired by the Authority; and

WHEREAS, "Authority" desires that the Consent Order and Agreement should be implemented in a manner approved by the Authority, the City of Pittsburgh, the Commonwealth of Pennsylvania, Department of Environmental Protection and the Allegheny County Health Department.

NOW, THEREFORE, BE IT RESOLVED, that the proper Officers of the Pittsburgh Water and Sewer Authority on behalf of said Authority, are hereby authorized and directed to enter into a a consent order and agreement with the City of Pittsburgh, the Commonwealth of Pennsylvania, Department of Environmental Protection and the Allegheny County Health Department. Said consent order and agreement to be in a form approved by the Executive Director and the Solicitor that is substantially the same as the form attached to this Resolution.

DULY ADOPTED AT A RECONVENED MEETING OF THE PITTSBURGH WATER AND SEWER AUTHORITY HELD ON DECEMBER 19, 2003

Richard W. Fleis

Secretary

THORP REED & ARMSTRONG

ATTORNEYS AT LAW SINCE 1895

Clifford B. Levine
Direct Dial 412 394 2396
Email: clevine@thorpreed.com

April 21, 2004

Bruce M. Herschlag, Esq.
Assistant Counsel
Pennsylvania Department of
Environmental Protection
Office of the Chief Counsel
400 Waterfront Drive
Pittsburgh, PA 15222-4745

Re: Pittsburgh Water and Sewer Authority ("PWSA") and the City of Pittsburgh ("City"): Consent Order and Agreement

Dear Mr. Herschlag:

At the request of the Department of Environmental Protection ("DEP"), the Pittsburgh Water and Sewer Authority ("PWSA") and the City of Pittsburgh ("City") are sending this letter to clarify our joint interpretation of Appendix H, Resolution No. 8 to the Consent Order and Agreement between PWSA and the City and the DEP, dated January 29, 2004 and executed by the DEP on or about April 21, 2004 ("COA"). Specifically, the second to last Whereas clause states as follows:

> Whereas, under the [Capital Lease Agreement dated July 15, 1995] the City has delegated responsibility for operation and maintenance of the System to the PWSA and expressly relies on the PWSA's capacity to fulfill its obligation thereunder.

First, please be advised that the City did not intend that any of the whereas clauses in the Resolution, including the one quoted above, would be incorporated as a substantive term and condition of the COA. Second, the above-quoted clause was merely intended to recite the City's legal position as it relates to PWSA.

Pittsburgh

Philadelphia

Princeton

Wheeling

Thorp Reed & Armstrong, LLP
One Oxford Centre
301 Grant Street, 14th Floor
Pittsburgh, PA 15219-1425
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ATTACHMENT C - APPENDIX A

THORP REED & ARMSTRONG

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April 21, 2004

Bruce M. Herschlag, Esq.
Assistant Counsel
Pennsylvania Department of
Environmental Protection
Office of the Chief Counsel
400 Waterfront Drive
Pittsburgh, PA 15222-4745

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Dear Mr. Herschlag:

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First, please be advised that the City did not intend that any of the whereas clauses in the Resolution, including the one quoted above, would be incorporated as a substantive term and condition of the COA. Second, the above-quoted clause was merely intended to recite the City's legal position as it relates to PWSA.

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APPENDIX G - CREDIT FOR PRIOR WORK FORM

CREDIT FOR PRIOR WORK FORM

COA Program Task	System Description	Protocol Compliant Prior Work	Program Scope for Remaining Work
Physical survey/visual inspection: Structure physical inspection	Number of structures: Total less New * = Remainder _____ – _____ = _____	Total number of credited structures: _____	Remaining number of structures to be inspected: _____
CCTV internal inspection	Length of public sewers in linear feet: Total less New * = Remainder _____ – _____ = _____	Total length of public sewer segments with protocol compliant CCTV inspection:	Length of segments needing CCTV inspection in linear feet:
Sewer system mapping	Length of public sewers in linear feet: Total less New * = Remainder _____ – _____ = _____	Completed mapping in linear feet:	Remaining mapping in linear feet to be compliant with protocols:
Sewer system mapping: Structure location survey	Number of structures: Total less New * = Remainder _____ – _____ = _____	Total number of credited structures: _____	Remaining number of structures to be surveyed: _____

* "New" means new construction that meets the applicable requirements of this Consent Order and Agreement

Total minus new equals the remainder of the system that is subject to the requirements of this Consent Order and Agreement

COA Program Task	System Description	Protocol Compliant Prior Work	Program Scope for Remaining Work
Sewer system mapping: Structure vertical elevations	Number of trunkline manholes, regulating structures, SSO Outfalls: Total less New * = Remainder ____ – ____ = ____	Total number of credited structures: ________	Remaining number of structures to be surveyed: ________
Sewer system dye testing:	Number of structures: Total less New * = Remainder ____ – ____ = ____	Total number of credited structures: ________	Remaining number of structures to be surveyed: ________
Hydraulic capacity evaluation	Length of trunkline plus length of segment with chronic wet weather problems in feet: ________	Length of trunkline where evaluation has been performed in feet: ________	Remaining length to be evaluated in feet: ________

* "New" means new construction that meets the applicable requirements of this Consent Order and Agreement

Total minus new equals the remainder of the system that is subject to the requirements of this Consent Order and Agreement

Submitted by City of Pittsburgh or Pittsburgh Sewer and Water Authority

I certify under the penalty of law that I believe the information provided in this document is true, accurate, and complete. I certify under penalty of law that I am familiar with the information submitted in this document and all attached documents and, to the best of my knowledge, information and belief and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

____

Name Date

Title

APPENDIX H

Resolution of the
Municipality
Authorizing signatories to enter into this Consent Order and Agreement

City of Pittsburgh
Certified Copy

510 City-County Building
414 Grant Street
Pittsburgh, PA 15219

State of Pennsylvania **Bill No:** 2004-0035

I, Linda M. Johnson-Wasler, the duly appointed Clerk of Council of the City of Pittsburgh, do hereby certify that the foregoing is a true and correct copy of:

Resolution No. 8

Resolution authorizing the Mayor to enter into the Consent Order and Agreement among the City, the PWSA, the Department of Environmental Protection and the Allegheny County Health Department.

Whereas, the City owns and has contracted with the PWSA to operate both sanitary sewer systems ("SSOs") and combined sewer systems ("CSS") within the City of Pittsburgh with the ALCOSAN service community (as such terms are defined in the Consent Order and Agreement attached hereto); and

Whereas, the City of Pittsburgh is a municipality subject to regulation under the Clean Streams Law, Act of June 22, 1937,P.L. 1987, as amended, 53 P.S. §§ 691.1-691.1001 ("Clean Streams Law"); and

Whereas, the Pittsburgh Water and Sewer Authority ("PWSA") is a municipal authority formed pursuant to the Authorities Act, the Act of May 2, 1945,P.L. No. 164, as amended, 53 P.S. §,§ 301 *et seq.* which is also subject to regulation under the Clean Streams Law, and

Whereas, the Commonwealth of Pennsylvania, Department of Environmental Protection ("Department") is the agency with the duty and authority to administer and enforce The Clean Stream Law; and

Whereas, the Allegheny County Health Department ("ACHD") is a health department organized under the Local Health Administration Law, Act 315 of August 24, 1951, P.L.1304, as amended, P.S. §§ 12001 *et seq.*, and executes powers and duties vested in it by laws of the Commonwealth, and the rules and regulations of the State Department of Health and other departments, boards, or commissions of the State government; and

Whereas, the Department alleges that the City and the Authority have taken actions in violation of the Clean Streams Law all as described in the Consent Order and Agreement attached hereto; and

Whereas, the City and the PWSA have engaged in an eighteen month process along with the other municipalities that comprise the ALCOSAN service community to obtain compliance with the National CSO policy and the elimination of sanitary sewer overflows which process has resulted in the Consent Order and Agreement attached hereto; and

Whereas, The Consent Order and Agreement requires the inventorying of the City's collection system, assessing the sewers and performing those repairs identified during the assessment that require immediate attention. In the second phase the City and PWSA agree to monitor the flow within the sewers and implement an operation and maintenance plan for SSO's and the Nine Minimum Controls for CSO's. Additionally, the City and Authority commit to work with ALCOSAN and the other municipalities within our basin group to identify those controls necessary to bring the collection system into compliance with the Clean Water Act; and

Whereas, under the [Capital Lease Agreement dated July 15, 1995] the City has delegated responsibility for operation and maintenance of the System to the PWSA and expressly relies on the PWSA's capacity to fulfill its obligation thereunder; and

Whereas, the City acknowledges its obligation to enact appropriate legislation necessary to comply with the Consent Order and Agreement;

Finally, that any Ordinance or Resolution or part thereof conflicting with the provisions of this Resolution, is hereby repealed so far as the same affects this Resolution.

Mayor's Approval Date: January 28, 2004

IN WITNESS WHEREOF, I have hereunto set my hand this 28th day of January, A.D. 2004.

Linda M. Johnson-Wasler, City Clerk	*January 28, 2004* *Effective Date*

APPENDIX I

Resolution of the
Authority
Authorizing signatories to enter into this Consent Order and Agreement

Four Gateway Center, 20th Floor
Pittsburgh, PA 15222

Tel: (412) 395-2023
Fax: (412) 395-8897

March 20, 2007

Mr. Michael D. Lichte, P.E.
Pittsburgh Water and Sewer Authority
441 Smithfield Street
Pittsburgh, PA 15222

Re: Evaluation of CSO Control Alternatives
DRAFT Technical Memorandum

Dear Mr. Lichte:

Enclosed for your review is the DRAFT Technical Memorandum on the process to be used for the Evaluation of CSO Control Alternatives. This process will be utilized by the PWSA CSO Team to evaluate and score alternatives that are being considered for use as CSO control alternatives.

This version contains updates related to review comments received from all Team members during the February – March 2007 time frame. We believe the metrics for scoring each individual alternatives evaluation criterion are well thought through. We would like PWSA's input on those metrics as well as on the weighting factors used to evaluate each criterion.

We look forward to your review of this draft document. Should you have any questions, please feel free to contact us.

Sincerely,

David R. Bingham
(For: CSO Consultant Team)
Vice President, Project Director

cc: Andrew Maul, PWSA

DRAFT

Evaluation of CSO Control Alternatives
DRAFT Technical Memorandum

EVALUATION OF CSO CONTROL ALTERNATIVES
DRAFT TECHNICAL MEMORANDUM

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TABLES

FIGURES

EVALUATION OF CSO CONTROL ALTERNATIVES

In order to evaluate each of the technical alternatives, the same economic, environmental, implementation and operational impact criteria that were used during the technology screening phase were utilized. These criteria are listed below in Table 1.

Table 1 - PWSA Long Term CSO Control Plan

Technology Screening Criteria

Economic Impact • Present Worth Cost (Capital, Operations and Maintenance)
Environmental Impact • Pollution Reduction • Impact on habitat, stream flooding, etc.
Implementation Impacts • Constructability • Permanent Land Requirements • Public Acceptance • Institutional Constraints • Siting Restrictions
Operational Impact • Operating Complexity • Flexibility • Reliability • Compatibility with other PWSA Facilities and Operations

However, the alternatives evaluation process included more detailed steps, including the "scaling" and "weighting" of each criterion. "Scaling" factors were determined using Utility Curves that were representative of the PWSA specific measure of the benefit of each criterion. "Weighting" factors were then determined to represent the relative importance of each criterion amongst the group. Once determined, the product of the scaling and weighting factors were used to determine the aggregate scores for each alternative. Finally, each alternative was scored over a range of control levels, i.e. 0 overflows per year, 2 overflows per year, etc. to ensure that the appropriate solutions were carried forward. In short, the process involved the following steps for each alternative:

- Obtain "Objective" score of alternative relative to each criterion. This was a very similar process to that used during Technology Screening.
- Apply the appropriate "Utility Curve" to each criterion.
- Obtain "Subjective" score of alternative relative to each criterion.

- Apply the appropriate “Weighting” factor to each criterion.
- Obtain “Weighted Subjective” score (“Subjective” score x “Weighting” factor) of alternative relative to each criterion.
- Sum the “Weighted Subjective” scores for the alternative.
- Obtain the “Alternative Score”.
- Repeat the process for each level of control for which the alternative is to be considered for use.

Each of the above steps is described in greater detail in the paragraphs that follow.

Objective Scoring. For every alternative, each criterion within the economic, environmental, implementation and operational impact criteria groups was objectively scored using defined quantitative or qualitative measures. A low score indicated that the alternative provided very little benefit with respect to that criterion, and a high score indicated that the alternative provided a great deal of benefit.

Quantitative measures, such as the alternative’s present worth cost or its land requirement (in acres), were used as scoring measures where applicable. For example, if the present worth of a series of alternatives ranged in cost from $2 million to $8 million, the $2 million alternative would be scored highest, the $8 million alternative would be scored lowest, and all other alternatives would be scored in the mid-range in accordance with their relative costs.

Qualitative measures were utilized when quantitative measures could not be applied. These measures were converted to relative numeric values by utilizing a scale ranging from one (1) to five (5). The positive impacts for a particular criterion were assigned a higher score, with five being the best score possible. Likewise, the negative impacts of a particular criterion were assigned lower scores, with one being the lowest score possible. To facilitate consistent and objective scoring, each qualitative measure was crafted as follows:

- A descriptive metric was provided for each score from one to five
- A supporting example of an alternative was provided
- No fractional scores were given

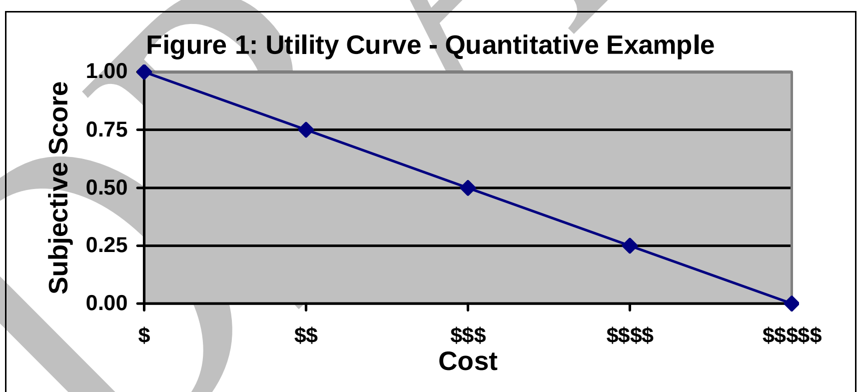
Once each criterion had been objectively scored, it was then subjected to a “scaling” process in order to obtain a PWSA specific measure of its benefit.

Utility Curves. Utility curves were formulated to convert the objective scores, as determined above, into scores that were directly representative of PWSA’s long term priorities. The development and use of criterion utility curves was dependent upon two factors: the criterion’s objective score as determined in the previous step, and the associated relative value of the criterion to PWSA. This “value” was referred to as the “subjective score” of the criterion.

For those criteria using quantitative scoring measures, numeric relationships between the objective and subjective scores were defined by a series of clear-cut metrics as shown in Table 2. These metrics were then plotted on a straight-line utility curve where the x-axis depicted the range of quantitative measures (cost, acres etc.), and the y-axis ranged from 0 to 1.0. Thus, the subjective score for a criterion was calculated by entering the curve at the appropriate location on the x-axis and calculating the corresponding y-axis value. For example, if a series of alternatives ranged in cost from $ to $$$$$, the x-axis would range from 1 to 5 in order to cover the variations in cost, as shown in Figure 1.

Table 2 - Example Quantitative Metrics

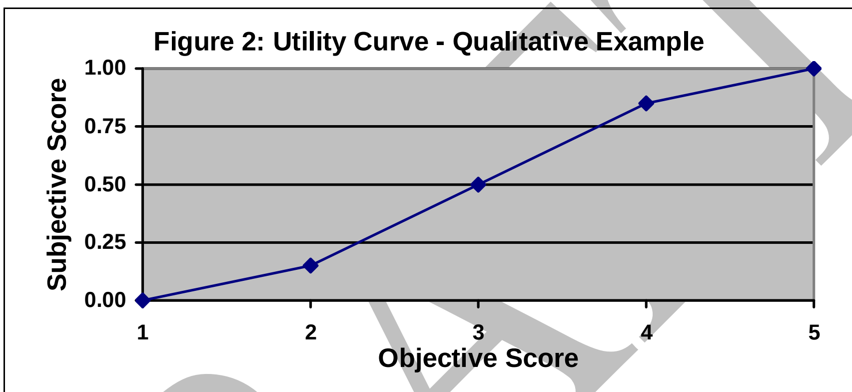
Score = X Value	Y Value	Metric	Example / Explanation
X = $	Y = 1	Very Low Cost	Lowest present worth cost of all alternatives.
X = $$	Y = 0.75	Low Cost	Fairly low present worth cost.
X = $$$	Y = 0.50	Moderate Cost	Moderate level of present worth cost.
X = $$$$	Y = 0.25	High Cost	Fairly high present worth cost.
X = $$$$$	Y = 0	Very High Cost	Highest present worth cost of all alternatives.



For those criteria for which qualitative scoring measures were applied (scores from 1 to 5), numeric relationships between the objective and subjective scores were also defined using clear-cut metrics as shown in Table 3, and were plotted on utility curves. The shape of these curves varied depending upon the relative values assigned by PWSA to each objective score. In fact, non-linear relationships were utilized in most cases to define significant differences between consecutive criterion scores. An example non-linear utility curve is shown below in Figure 2.

Table 3 - Example Qualitative Metrics: Non-Linear

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0.0	Very Low Value	Alternative provides the lowest value.
X = 2	Y = 0.15	Low Value	Alternative provides low value.
X = 3	Y = 0.50	Moderate Value	Alternative provides moderate value.
X = 4	Y = 0.85	High Value	Alternative provides high value.
X = 5	Y = 1.0	Very High Value	Alternative provides the highest value.



Subjective Scoring. For every alternative, each criterion within the economic, environmental, implementation and operational impact criteria groups was subjectively scored using its objective scores and its associated utility curve. As was the case with the objective scores, a low score indicated that the alternative provided very little benefit with respect to that criterion, and a high score indicated that the alternative provided a great deal of benefit. The procedure used to develop each of the utility curves is described below.

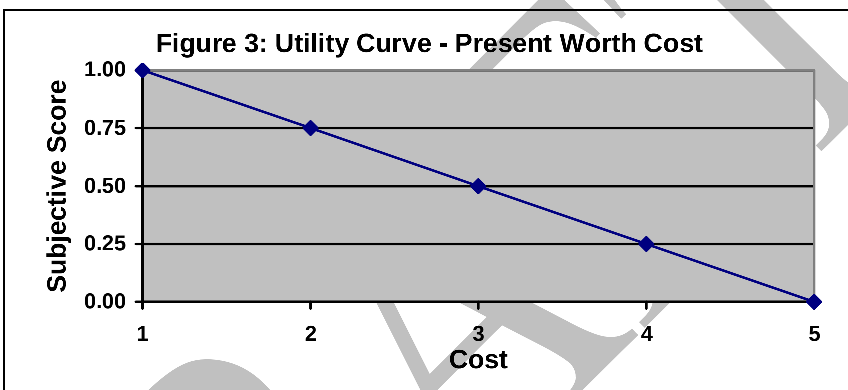
Economic impacts of CSO technologies were measured by evaluating the following parameter:

- Present Worth Cost

<u>Present worth cost</u> comparisons were based on the metrics shown in Table 4 and their associated straight-line utility curve covering the range of present worth costs for each alternative. Figure 3 depicts the associated cost utility curve.

Table 4 - Present Worth Cost Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 1	Very Low Cost	Lowest present worth cost of all alternatives.
X = 2	Y = 0.75	Low Cost	Fairly low present worth cost.
X = 3	Y = 0.50	Moderate Cost	Moderate level of present worth cost.
X = 4	Y = 0.25	High Cost	Fairly high present worth cost.
X = 5	Y = 0	Very High Cost	Highest present worth cost of all alternatives.



Using this curve, if example “Alternative X” had a present worth cost of $$ for Control Level I, its subjective score would be 0.75.

Environmental Impacts of CSO technologies were measured by evaluating the following parameters:

- Pollution Reduction
- Impact on Habitat, Stream, River etc.

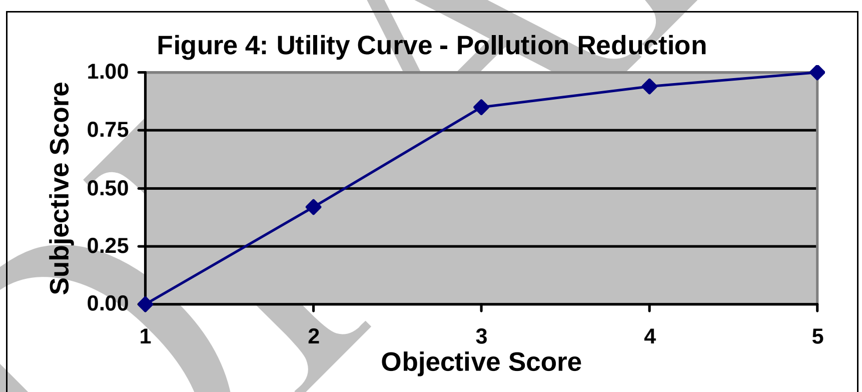
Pollution reduction was delineated using a parabolic relationship across the range of objective scores. The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 5.

Table 5 - Pollution Reduction Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)

X = 2	Y = 0.42	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. For example, swirl concentrator in highly variable flow regimes. Also, the net effectiveness of sewer separation resulting from the large increase of storm water pollutant loading as compared to reduction of CSO.
X = 3	Y = 0.85	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF or increased primary tankage at WWTP.
X = 4	Y = 0.94	Between Primary and Secondary Treatment	Alternative ensures at least minimum treatment per EPA guidelines and could provide up to full secondary treatment at times. For example, deep storage tunnels and underground storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.
X = 5	Y = 1	Secondary Treatment	Alternative provides full secondary treatment for CSO at all times. For example, construction of WWTP.

The corresponding utility curve is illustrated below in Figure 4.



Using this curve, if example "Alternative X" received an objective score of 2.0 for Control Level I, its subjective score would be 0.42.

The utility curve reflects a large increase in criterion value as the scores range from one to three because the EPA CSO presumptive treatment levels, as published in the 1994 EPA National CSO Policy, require equivalent primary treatment for combined sewer overflows. Therefore, the progressive values for the range of minimal to primary treatment were substantially less than those values for the range of primary to secondary treatment.

Treatment levels exceeding that of primary treatment increase the relative benefit of the alternative, but since these levels of treatment are not required to meet the goals of this plan. Thus, the relative benefit levels off at these levels.

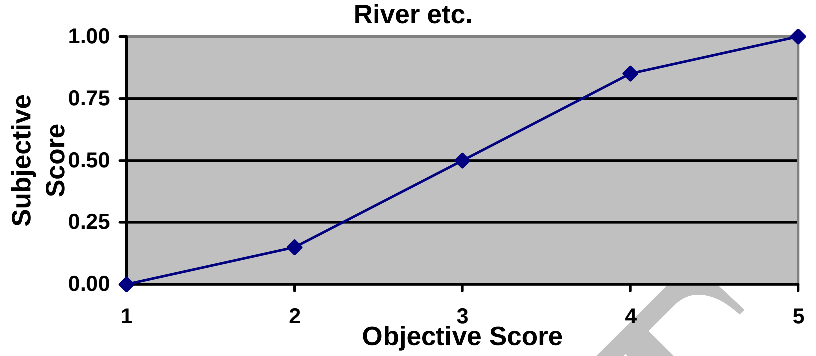
Impacts on Habitat, Stream, River etc. were measured using an "S-curve" relationship across the range of scores. The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 6.

Table 6 - Impact on Habitat, Stream, River etc. Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. For example, constructing large treatment facility with centralized effluent in natural resource habitat with streams, lakes, wildlife, etc.
X = 2	Y = 0.15	Moderate Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. For example, moderate sized storage / treatment facility in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that include disinfection that could discharge harmful chemical by-products, i.e. TRC or THMs, if dechlorination is not included.
X = 3	Y = 0.50	No Impact	Alternative does not change habitat characteristics or increase erosion. For example, end-of-pipe treatment facilities without disinfection by-products located away from stream and natural habitats. Flows are treated, but volume / frequency remain the same with respect to flooding / erosion.
X = 4	Y = 0.85	Moderate Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.
X = 5	Y = 1	Positive Impact	Alternative eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.

The corresponding utility curve is illustrated below in Figure 5.

Figure 5: Utility Curve - Impact on Habitat, Stream, River etc.



Using this curve, if example “Alternative X” received an objective score of 4.0 for Control Level I, its subjective score would be 0.85.

The “S-curve” configuration reflects the varying magnitudes of impacts from negative to positive across the range of scores. The scores of one and two indicate negative impacts to the habitat, stream flooding, and erosion caused by a particular alternative, and any negative impact is considered to be a severe disadvantage. A score of three indicates that the alternative is expected to have a neutral impact. Scores of four and five indicate that the alternative has a positive impact to habitat, stream flooding and erosion, with any positive impact being considered to be greatly advantageous.

Implementation Impacts of CSO technologies were measured by evaluating the following parameters:

- Constructability
- Permanent land requirements
- Public acceptance
- Institutional constraints
- Siting restrictions

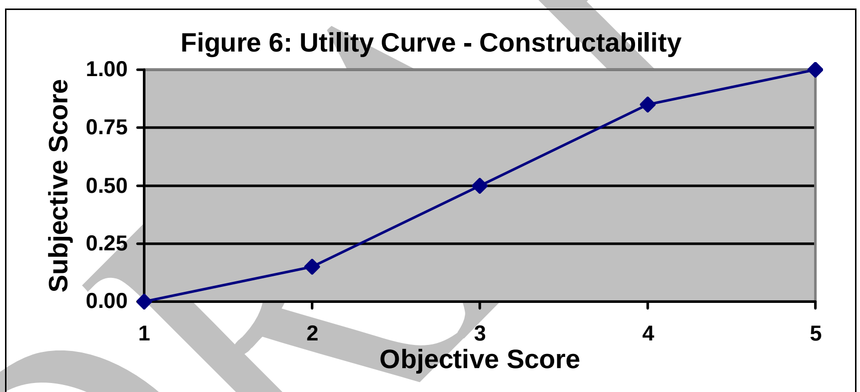
Constructability parameters can be measured using an “S-curve” relationship across the range of objective scores. The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 7.

Table 7 - Constructability Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Extreme Community Disruption	Extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. For example, complete open-cut sewer separation in large, heavily populated area.

X = 2	Y = 0.15	Significant Community Disruption	Significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area.
X = 3	Y = 0.50	Moderate Community Disruption	Moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area.
X = 4	Y = 0.85	Minimal Community Disruption	Minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation.
X = 5	Y = 1	No Community Disruption	Alternative produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.

The corresponding utility curve is illustrated below in Figure 6.



Using this curve, if example "Alternative X" received an objective score of 3.0 for Control Level I, its subjective score would be 0.50.

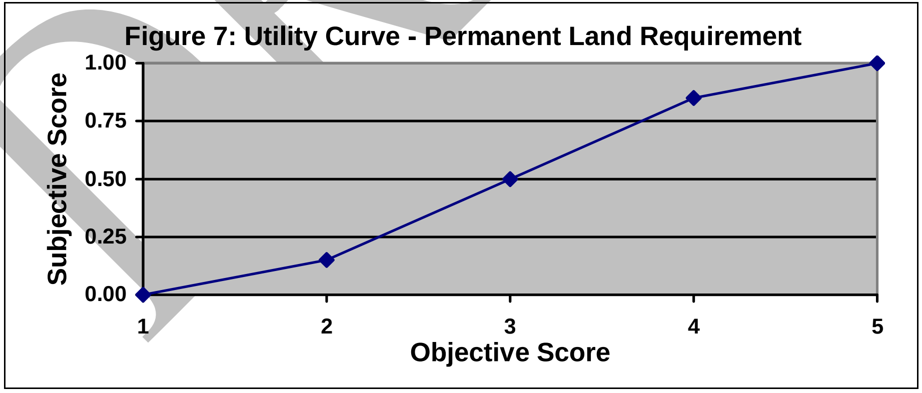
The "S-curve" configuration again reflects the varying magnitudes of impacts from negative to positive across the range of scores. The scores of one and two indicate, respectively, extreme and significant disruptions to the community during the construction phase of the alternative. A score of three indicates that the alternative is expected to have a moderate impact. Scores of four and five indicate that the alternative is expected to have a minor or very little impact on the community, respectively. Significant impacts were deemed to be much worse than moderate impacts, and mimor impacts were deemed to be much better than moderate impacts, so the curve was adjusted to reflect that steep increase in relative benefit between scores of two and four.

Permanent land requirement scores were based on a quantitative comparison of the approximate relative land required to build the proposed CSO control alternatives. Objective scores ranged from a "five" if no land was required to a "one" if a large amount of land was required. The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 8.

Table 8 - Permanent Land Requirement Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.
X = 2	Y = 0.15	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.
X = 3	Y = 0.50	Moderate Land Requirement	Alternative has moderate permanent land requirement. For example, construction of tunnel storage would require access shafts and other appurtenances that in total, would use less land than other storage methods.
X = 4	Y = 0.85	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only.
X = 5	Y = 1	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.

The corresponding utility curve is illustrated below in Figure 7.



Using this curve, if example "Alternative X" received an objective score of 3.0 for Control Level I, its subjective score would be 0.50.

The relative impact of land requirements was deemed to be accentuated by the fact that extreme land requirements were much worse than moderate, minimal or no land requirements. Thus, as the land requirement increased, the subjective score decreased in an "S" shaped manner.

Public acceptance scores were based on a straight-line comparison of the estimated level of public acceptance for each alternative. Only three objective scores were used:

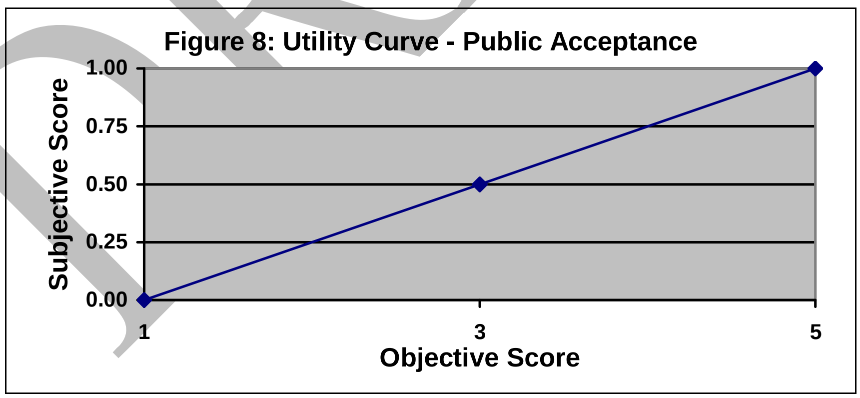
- 1 – strong public opposition
- 3 – no public reaction
- 5 – strong public support

The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 9.

Table 9 - Public Acceptance Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas.
X = 3	Y = 0.50	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization, etc. rarely solicit significant negative reactions.
X = 5	Y = 1	Strong Public Support	Alternative would likely be embraced by the impacted public. For example, scenic park and wetland that enhances neighborhood and increases property values, while controlling CSOs.

The corresponding utility curve is illustrated below in Figure 8.



Using this curve, if example “Alternative X” received an objective score of 3.0 for Control Level I, its subjective score would be 0.50.

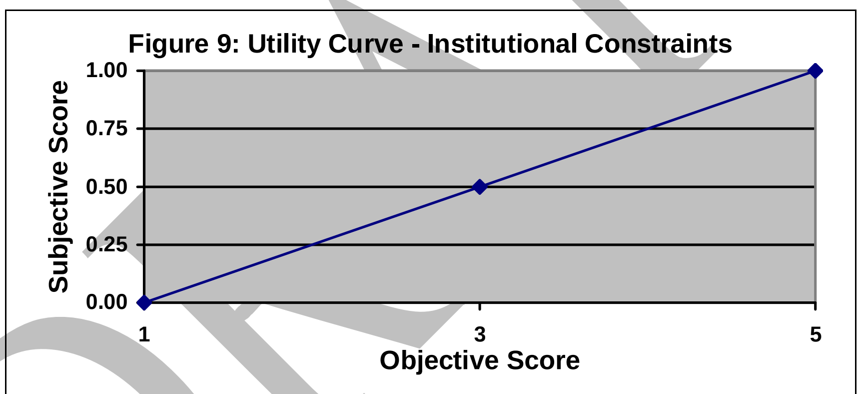
The relative impact of Public Acceptance was deemed to be directly proportional to the level of acceptance. Thus, as the level of acceptance increased, the subjective score increased proportionately.

Institutional constraint scores were based on a quantitative comparison of the level at which a particular alternative fell within the jurisdictional responsibility of PWSA. The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 10.

Table 10 - Institutional Constraint Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.
X = 3	Y = 0.50	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.
X = 5	Y = 1	Complete PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.

The corresponding utility curve is illustrated below in Figure 9.



Using this curve, if example "Alternative X" received an objective score of 5.0 for Control Level I, its subjective score would be 1.00.

Siting restriction criterion subjective scores were based on a straight-line comparison of the estimated level of project approvals and permitting. Only three objective scores were used:

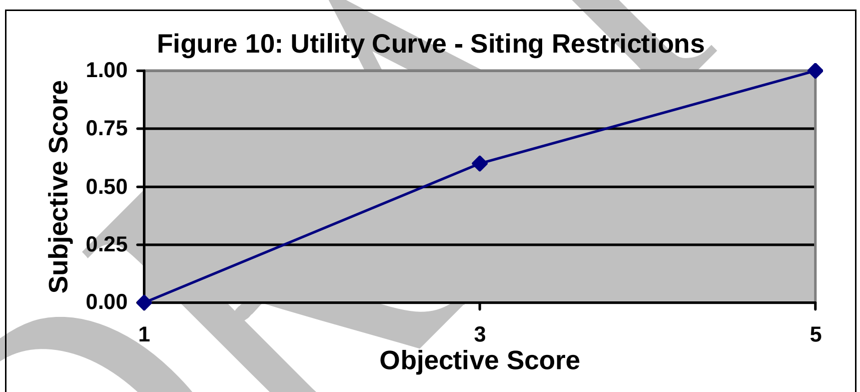
- 1 – strong public opposition
- 3 – no public reaction
- 5 – strong public support

The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 11.

Table 11 - Siting Restriction Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Difficult Req's	Alternative requires extensive approval process involving permitting / acceptance effort. For example, an emerging technology, such as ballasted flocculation, with no history of prior installations, may require pilot facilities and engineering studies. Also, an alternative which requires a series of wetland, architectural and community permits. For example, a large relief or consolidation sewer constructed in open cut in the Oakland area.
X = 3	Y = 0.60	Moderate Req's	Normal review and approval process requiring minimal permits. For example, a tunnel located within existing right-of-ways, requiring plan review and approval from three or less authorities.
X = 5	Y = 1	No Req's	No permits required. For example, expanding existing PWSA facilities, such as raising weirs.

The corresponding utility curve is illustrated below in Figure 10.



Using this curve, if example "Alternative X" received an objective score of 2.0 for Control Level I, its subjective score would be 0.30.

Operational impacts of CSO technologies were screened by reviewing the following parameters:

- Operating complexity
- Flexibility
- Reliability
- Compatibility with other PWSA facilities and operations

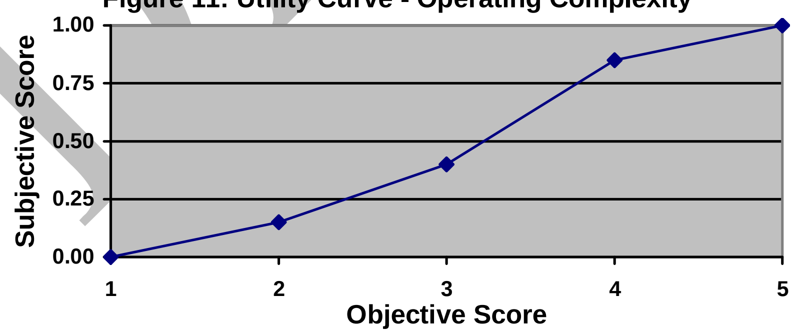
Operating complexity scores defined the relative difficulty in operating the various control alternative equipment and systems. The utility curve can be defined using an "S-curve" relationship across the range of objective scores. The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 12.

Table 12 - Operating Complexity Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Extremely Complex; Requires Significant Training and/or Staff	Example: High rate end-of-pipe treatment alternatives.
X = 2	Y = 0.15	Difficult to Operate; Requires Specific Training	Example: elaborate real-time control alternatives.
X = 3	Y = 0.40	Moderately Complex; Requires General Training	Example: CSO treatment facility such as detention and treatment.
X = 4	Y = 0.85	Simple to Operate; Requires Limited Training	Example: Storage / conveyance tunnels with pump station.
X = 5	Y = 1	Little or No O&M Required	Example: Sewer separation.

The corresponding utility curve is illustrated below in Figure 11.

Figure 11: Utility Curve - Operating Complexity



Using this curve, if example "Alternative X" received an objective score of 4.0 for Control Level I, its subjective score would be 0.85.

The curve configuration reflects the large relative differences between "Moderately Complex" and "Simple to Operate". Alternatives deemed to be moderate or higher on the complexity scale deliver very little benefit for PWSA, while those alternatives that have little or no complexity deliver a great amount of benefit to PWSA. Thus a large jump in the subjective score occurs when the objective score increases from three to four.

Flexibility scores were based on a straight-line comparison of the estimated relative ability of the prospective control alternatives to accommodate future expansion. This is consistent with the EPA CSO Control Policy's requirement to accommodate future expansion, if required. The three objective scores were:

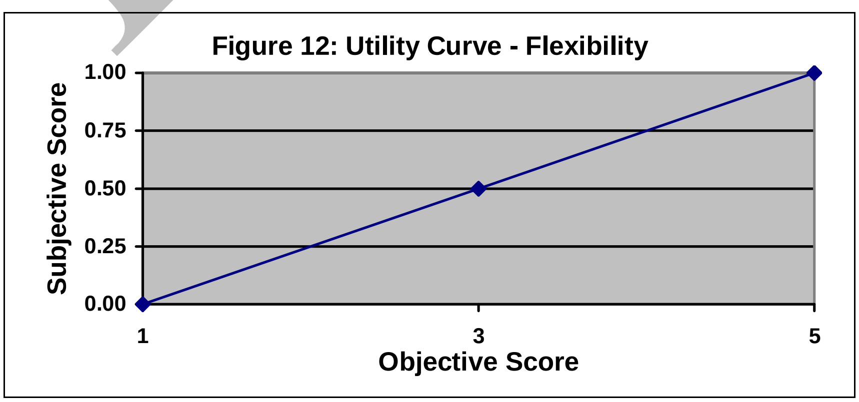
- 1 – inability to expand
- 3 – limited ability to expand
- 5 – easily expanded

The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 13.

Table 13 - Flexibility Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	Cannot be Expanded for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion.
X = 3	Y = 0.50	Could be Expanded on a Limited Basis, with Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion.
X = 5	Y = 1	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity.

The corresponding utility curve is illustrated below in Figure 12.



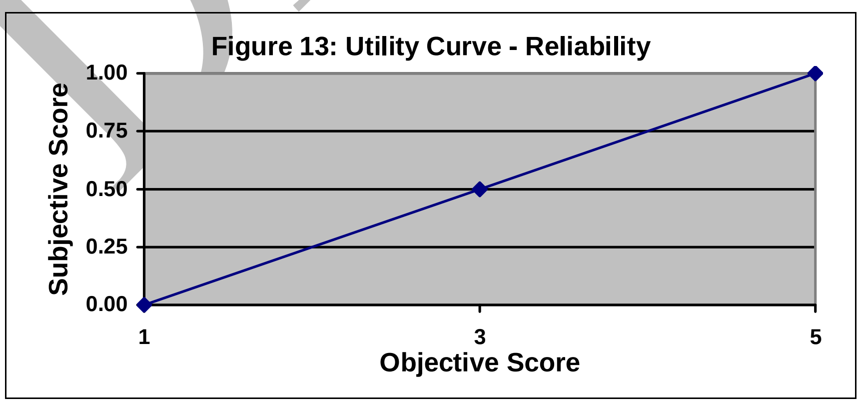
Using this curve, if example "Alternative X" received an objective score of 1.0 for Control Level I, its subjective score would be 0.00.

Reliability parameters were developed to measure the potential alternatives with regard to their relative operational reliability, based upon their respective performance histories. Certain alternative are more consistent in the performance of adequate CSO control than others that may have known maintenance problems or reported design shortcomings. Subjective scores were based on a straight-line comparison as presented in Table 14.

Table 14 - Reliability Metrics

Score = X Value	Y Value	Metric	Example / Explanation
X = 1	Y = 0	History of Significant Problems or Limited Track Record	Example: High rate end-of-pipe alternatives.
X = 3	Y = 0.50	Moderately Reliable, Requires Routine Maintenance & Repair	Example: CSO treatment facilities.
X = 5	Y = 1	Minimal Maintenance with Proven Track Record	Example: Storage / conveyance tunnel.

The corresponding utility curve is illustrated below in Figure 13.



Using this curve, if example "Alternative X" received an objective score of 3.0 for Control Level I, its subjective score would be 0.50.

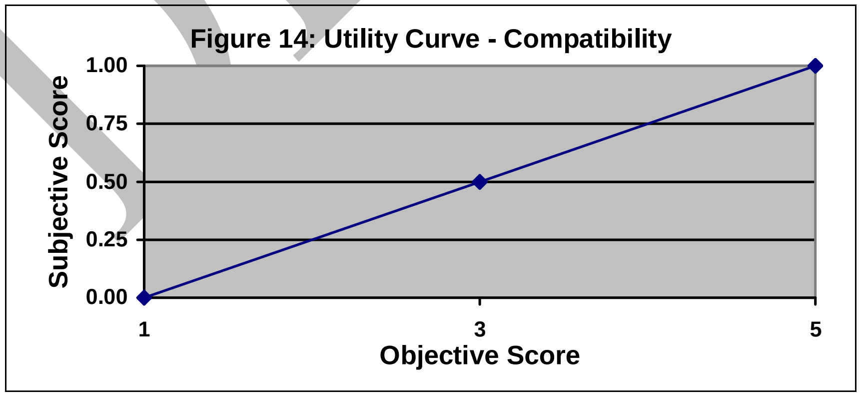
Compatibility scores were devised to measure the relative compatibility of proposed CSO control alternatives with current PWSA operating systems.

Preference was given to technologies for which PWSA had trained operations and maintenance personnel on staff, and to technologies that did not have a negative impact on downstream facilities. Higher consideration was also given to technologies that did not require extensive and/or remote facility operations and maintenance needs. The subjective scores for the prospective alternatives were based on the scaled metrics presented in Table 15.

Table 15 - Compatibility Metrics

Score	Y Value	Metric	Example / Explanation
X = 1	Y = 0	No PWSA Experience	Example: High rate end-of-pipe alternatives.
X = 2	Y = 0.15	Very little PWSA Experience	Example: CSO Treatment Facility such as detention and treatment.
X = 3	Y = 0.35	Limited PWSA Experience	Example: Surface storage systems.
X = 4	Y = 0.50	Moderate PWSA Experience	Example: Storage and conveyance conduits.
X = 5	Y = 1	Extensive PWSA Experience	Example: Sewer separation.

The corresponding utility curve is illustrated below in Figure 14.



Using this curve, if example "Alternative X" received an objective score of 5.0 for Control Level I, its subjective score would be 1.00.

Weight Factors. The scores, metrics, and utility curves developed above established relative measures for each criterion with which to rate competing CSO control alternatives. However, the importance of each criterion, relative to all other criteria, varied as well. Some criteria were valued more in the decision making process than others. In order to determine the appropriate relative weighting of each individual criteria, a workshop was conducted with the impacted PWSA stakeholders. Representatives from PWSA attended the session.

During the workshop, the objective scores, metrics, subjective scores and utility curves for each criterion were presented and confirmed with PWSA stakeholders. Then, using a direct weighting method via point allocation, PWSA personnel were asked to allocate 100 points among the four major evaluation criteria categories: economic, environmental, implementation and operational.

After the major criteria categories were assigned a relative point value, that point value was further sub-divided amongst each individual criterion within that category. As such, each criterion was assigned a point total, and the sum of all individual criterion point values was equal to 100 points.

The results from the participants were averaged and standardized to a total sum of 1.00. In other words, the sum of the resulting decimal values for all criteria equaled 1.00. The results of the weight assignments are presented in Table 16.

Table 16 - Results of Criteria Weighting Workshop (example)

Criteria Group	Criterion	Category Point Value	Criterion Point Value(s)	Weight Factor	Criterion Rank
Economic Impact	Present Worth Cost	25	25	0.250	
Environmental Impact	Pollution Reduction	25	12.5	0.125	
	Impact on Stream, River etc.		12.5	0.125	
Implementation Impact	Constructability		5.0	0.050	
	Permanent Land Requirements		5.0	0.050	
	Public Acceptance	25	5.0	0.050	
	Institutional Constraints		5.0	0.050	
	Siting Restrictions		5.0	0.050	
Operational Impact	Operating Complexity		6.25	0.063	
	Flexibility		6.25	0.063	
	Reliability	25	6.25	0.063	
	Compatibility w/ Other PWSA Facilities & Operations		6.25	0.063	
	Totals:	100	100	1.0	

Weighted Subjective Scoring. Once the weight factors were determined for each criterion, they were multiplied by the criterion's subjective score. The result was the weighted subjective score for each criterion.

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March 20, 2007

Mr. Michael D. Lichte, P.E.
Pittsburgh Water and Sewer Authority
441 Smithfield Street
Pittsburgh, PA 15222

Re: Basis of Cost for CSO Control Technologies
DRAFT Technical Memorandum

Dear Mr. Lichte:

Enclosed for your review is the DRAFT Technical Memorandum on the process to be used to develop present worth costs for various CSO control technologies. This process will be utilized by the PWSA CSO Team to develop planning level cost estimates for recommended CSO control alternatives.

This version contains updates related to review comments received from all Team members during the February – March 2007 time frame. We believe the metrics for the estimates are well thought through. We would like PWSA's input on those metrics.

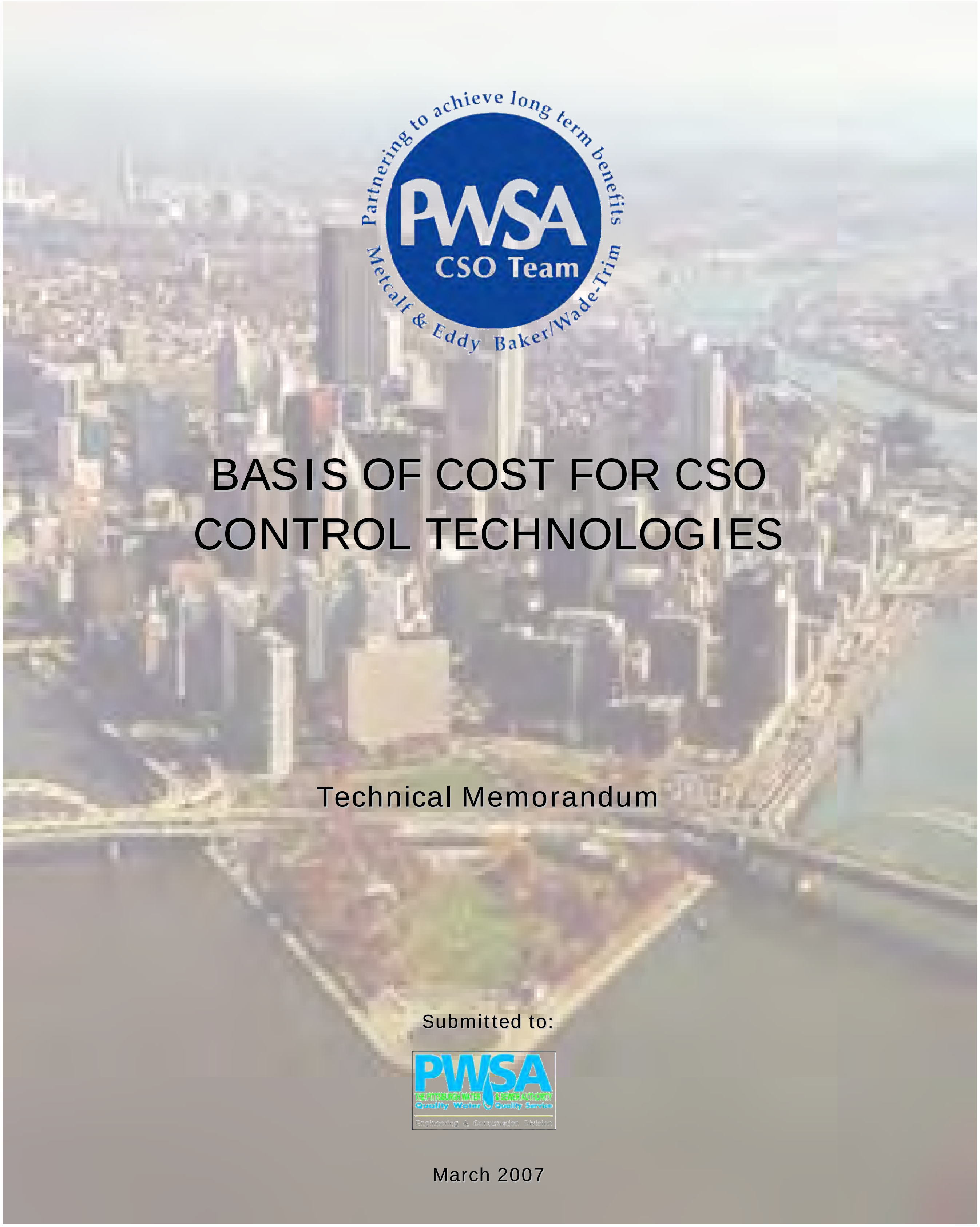
We look forward to your review of this draft document. Should you have any questions, please feel free to contact us.

Sincerely,

David R. Bingham
(For: CSO Consultant Team)
Vice President, Project Director

cc: Andrew Maul, PWSA

ATTACHMENT C - APPENDIX B



BASIS OF COST FOR CSO CONTROL TECHNOLOGIES

Technical Memorandum

Submitted to:

PWSA

March 2007

PITTSBURGH WATER AND SEWER AUTHORITY
LTCP PROJECT FOR THE ABATEMENT OF CSO'S

BASIS OF COST FOR CSO CONTROL TECHNOLOGIES
TECHNICAL MEMORANDUM

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BASIS OF COST FOR CSO CONTROL TECHNOLOGIES

CSO CONTROL TECHNOLOGIES

An extensive list of feasible CSO control technologies was compiled and evaluated for the Pittsburgh Water and Sewer Authority (PWSA) service area. The technologies and evaluation methodology are described in the memo entitled CSO Technology Screening Technical Memorandum.

The four functional categories of wet weather CSO control are:

- Source Control
- Collection System Controls
- Storage
- Treatment

Equations were developed to estimate the planning level capital costs associated with the construction of each of these functional categories, varying when necessary by the type of the control facility. Operation and maintenance costs were also prepared to estimate the typical costs associated with upkeep and general operation of the facilities. Costs were accelerated to include future costs attributed to long term financing for the control technologies. Long term depreciation was also considered.

The cost information provided herein encompasses the following methods of CSO control technologies:

Source Control Technologies – Used to control infiltration and inflow (I/I) into the system which overloads collection systems already undersized for conditions.

- Sewer and Manhole Rehabilitation – Typical of trenchless methods such as cured-in-place pipe lining (CIPP), gunite application and sliplining.

Collection System Control Technologies – Constructed to redirect flows to other areas of the system or to provide additional control to the existing system.

- Relief Sewer Construction – Open-cut construction of new sewers, including relief sewers. Includes connection of new / existing pipelines to new / existing interceptor conduits and ancillary items such as manholes, residential service connections and site restoration.
- Sewer System Optimization – Includes the removal of "bottlenecks" in the sewer system, sewer cleaning and maintenance, and polymer injection / lining of the pipes to reduce friction and increase flow capacity.
- Sewer Separation – Construction of new pipelines in a combined sewershed to segregate sanitary and storm water flows into specific pipes. As with new sewer construction, the cost equations consider ancillary items and work.
- Regulator Optimization – Modification of existing regulating structures and construction of new structures.
- Pump Stations and Force Mains – Screening and odor control facilities are usually installed, but are not included in the station pricing. In addition, pumping stations and associated force mains are generally constructed in conjunction with various storage and treatment facilities.

Storage Technologies – Constructed to temporarily store CSO flows until the collection and conveyance system equalizes and the stored waters can be reintroduced back to the collection and conveyance system.

- Storage Tunnels – Construction of large diameter tunnels in either in soft ground (shallow) or bedrock (deep). Excess flows are directed to the tunnel and are subsequently pumped back to the system as hydraulic conditions permit. Typical ancillary construction includes access shafts, regulating structures and screening, pumping (dewatering) and odor control facilities.

- Storage Tanks – Construction of either below or above grade storage tanks. Typical ancillary construction includes screening, pumping and odor control facilities.
- In-Line Storage – Construction of an inflatable dam or other method to partially or fully block the flow within a pipe in order to utilize the existing hydraulic capacity of the pipe for storage. Once the high flows begin to recede, the dam is deflated and the stored waters can be reintroduced back to the collection and conveyance system. Hydraulic capacity is utilized by allowing the pipeline to surcharge during storm events to an acceptable level without causing upstream flooding.

Treatment Technologies – Method of CSO management whereby discharged waters are provided with some degree of treatment to reduce the quantity of floatables, suspended solids and pathogens released to local receiving waters. Ancillary construction usually includes screening, pumping, odor control and disinfection facilities.

- Combined Sewer Overflow Treatment Facilities (CSOTF) – Sedimentation and storage tanks used to temporarily store stormwater and remove suspended solids in the water by allowing them to settle by gravity.
- High Rate End of Pipe Treatment (Actiflo/DensaDeg) – Technology using ballasted flocculation methods to removed suspended solids at a rapid rate.
- Vortex Separator (Swirl Concentrator) – Removes suspended solids by forcing water in a circular direction, thus separating suspended solids of differing densities and allowing them to settle in the center of the unit.
- Disinfection – Method of destroying pathogens and bacteria in CSO effluent that would typically be released to local waterways. Typically constructed in conjunction with other treatment technologies. For the purposes of this cost evaluation, chlorine disinfection was assumed.
- Screening – Used to remove coarse solids and floatables from CSO. Typically constructed in conjunction with other treatment methods, as well as other methods of CSO control such as pumping stations.

PRESENT WORTH COSTS

Present Worth Costs - The purpose of the economic analysis is to convert life cycle costs, including total capital costs, useful facilities life estimates and annual O&M costs, to Present Worth Costs to allow consistent economic comparisons between alternatives. Economic factors of concern include the planning interest rate and the economic life of capital expenditures.

- Interest rate – A Pennsylvania Department of Environmental Protection (PaDEP) interest rate is used for this analysis. The current rate, established per PaDEP for fiscal year 2007 is 6.625 percent and is used in this economic analysis.
- Economic life - The assigned service life for each component is based on EPA cost-effectiveness guidelines.

Capital Costs - Capital costs are defined as the combination of construction costs, land costs and non-construction costs such as permitting, design fees, legal fees, bonds, insurance and contingencies.

Planning level opinions of probable costs for CSO control alternative components were based on actual contractor bids, when available, for similar control technologies previously planned for construction by various municipal entities across the country. The mean contractor bid was adjusted for inflation and was used for the PWSA CSO alternative evaluation process. Cost information was summarized and plotted versus associated parameters such as pipe diameter, maximum volume, peak flow rate, etc. The resulting equation of the "best fit line" was used to estimate the cost of various CSO control methods.

The following represents the assumptions and considerations used to arrive at the opinion of probable costs for key construction components of the PWSA CSO Long Term Control Plan:

- General – The following general considerations were accounted for or included in the capital costing methodology:
    1. Land acquisition costs were assumed to be $2 / SF. Buried pipelines, both gravity and force main, are assumed to be constructed within the local utility or road rights-of-way, thus negating land acquisition fees for this type of construction.

2. Restoration of local roadways is assumed to be full depth aggregate backfill over the excavation and curb to curb pavement resurfacing.

3. Construction costs include the complete construction of the facilities and restoration of the construction site.

4. Native materials and debris located within pipeline right-of-ways were assumed to be non-hazardous or uncontaminated.

5. Five to ten percent mobilization / demobilization fees are accounted for in the cost equations. These fees also include ancillary "office" or "non-construction" tasks and fees such as surveys, permitting, bonds, storage, etc. Traffic control, sheeting and shoring, dewatering and bypass pumping fees are also included in the cost equations.

6. Construction cost data was accelerated to 2007 values for the Pittsburgh region using CCI indices.

- Sewer Rehabilitation – Costs were expressed in dollars per lineal foot of pipe rehabilitated, and were function of pipe diameter. The following assumptions were made when developing the cost equation:

  1. No differentiation in pricing was made between CIPP, gunite and slipline rehabilitation methods.

  2. The following appurtenant work was included in the general cost equation:

     - Pipe cleaning and debris removal
     - CCTV inspection
     - Lateral reinstatement
     - Point repairs

- Relief Sewer Construction – Costs were expressed in dollars per lineal foot of gravity pipeline constructed, and were a function of pipe diameter and depth of burial. The following assumptions were made when developing the cost equation:

  1. No differentiation in pricing was made between pipe materials.

2. Costs per linear foot of pipe were developed for burial depth ranges of less than 16 feet and greater than 16 feet. Depths were approximated along the entire length of the sewer run.

3. The following appurtenant work was included in the general cost equation:

   - Trench excavation, bedding, backfill and compaction
   - Lateral reconnections
   - Manhole installation

4. The cost for connecting local sewers and trunk lines to large diameter interceptors was calculated using a separate cost equation. The connection cost was based upon the diameter of the connecting conduit. The following appurtenant work was included in the interceptor connection equation:

   - Trench excavation, bedding, backfill and compaction
   - Manhole installation
   - Limited quantity, typically 500 LF or less, of new interconnecting pipe

- Sewer Separation – Costs were expressed in dollars per acre of sewershed separated, and were a function of the sewershed locale, i.e. “urban” or “suburban”. The following assumptions were made when developing the cost equations:

  1. High traffic areas with restrictive work zones greatly influence the locale designation. Each sewershed was evaluated on a case by case basis to determine locale designation. Costs used were:

     - $150,000 / acre for areas outside of the downtown metropolitan area
     - $200,000 / acre for the downtown area and other high population density areas

  2. Partial sewer separation costs were calculated by multiplying the above costs (as applicable) by the percentage of the specific area classification within the sewershed requiring separation.

- Regulator Optimization – Costs were expressed in dollars per regulator, and were a function of the type of regulator installed or the modifications completed. The following assumptions were made when developing the cost equation:

    1. *New regulator construction* involved installation of a completely new regulating structure and appurtenances. New regulators were classified as follows:

        - Static – Regulate flow by stationary methods such as weir walls.

        - Automatic – Regulate flow using automated technology that operates as a function of hydraulic conditions.

    2. *New regulator construction within an existing structure* consisted of the installation of a new regulating control device, including demolition of the existing device as required, within an existing chamber. Such devices include new weir walls and tipping gates.

    3. *Modification of an existing regulator* included general improvements or enhancements to permit additional control of flows within the structure. Such work included raising or lowering a stationary weir wall or adjusting the orifice opening on a tipping gate.

    4. The following appurtenant work was included in the general cost equation:

        - Demolition and / or removal of existing structure as required

        - Instrumentation, controls and telemetry for automatic regulators

        - Reconnection of influent and effluent piping

- Pump Stations and Force Mains – Pump station costs were expressed in million dollars per MGD pumped, and were a function of the peak pumping capacity. Force main costs were expressed in dollars per lineal foot of pipeline constructed, and were a function of pipe diameter. The following assumptions were made when developing the cost equation:

    1. Screening and odor control facility costs were calculated separately from the station costs. Ancillary open cut sewer costs were not included in pump station pricing.

2. Pumping stations were typically required as appurtenant features to other CSO control methods such as storage tanks and tunnels. Station costs were calculated separately from these control technologies.

3. Large capacity stations may require construction of unusually large diameter shafts and wet wells. Under these conditions the cost of the station became more a function of the concrete, excavation and the structure in general versus the peak capacity. In such instances a more detailed cost estimate may have been completed to adequately price the station.

4. Pump station cost equations were developed for peak flow conditions of less than 10 MGD and for greater than 10 MGD.

5. The following appurtenant work were included in the general pump station cost equation:

    - Wet well
    - Instrumentation, controls and telemetry
    - Valves and internal piping
    - Control building

6. Force main average depth of burial was typically 5 vertical feet.

7. No differentiation in pricing was made between pipe materials.

8. The following appurtenant work was included in the general force main cost equation:

    - Trench excavation, bedding, backfill and compaction
    - Connection to new or existing manholes or other structures

- Rock / Soft Ground Storage Tunnels – Costs were expressed in dollars per linear foot of tunnel constructed, and were a function of the tunnel diameter and anticipated geologic conditions. The following assumptions were made when developing the cost equation:

    1. Costs for "Rock" tunneling, i.e. through bedrock, were calculated using a different equation than that used for "Soft Ground", i.e. soft rock / soil tunneling.

2. Pumping, screening, regulator and odor control facility costs were calculated separately from the tunnel costs.

3. Related open cut sewer and force main costs were not included in tank pricing and were calculated separately.

4. The following appurtenant work was included in the general cost equation:

    - Construction of access and air relief shafts
    - Ancillary piping

- Above / Below Grade Storage Tanks – Costs were expressed in million dollars per MG storage, and were a function of the type of tank constructed, above or below grade. The following assumptions were made when developing the cost equations:

    1. Pumping, screening and odor control facility costs were calculated separately from the tank costs.

    2. Related open cut sewer and force main costs were not included in tank pricing and were calculated separately.

    3. No differentiation in pricing was made between tank materials of construction, i.e. steel vs. concrete.

    4. The following appurtenant work was included in the general cost equation:

        - Valving and ancillary piping, including overflow piping and connections to existing manholes, structures or other facilities
        - Control building, instrumentation, controls and telemetry
        - Tank foundation including excavation, bedding and backfill
        - Interior support for below grade tanks
        - Tank flushing system
        - Cathodic protection

- In-line Storage (Inflatable Dams) – Costs were expressed in dollars, and were a function of the pipe diameter. The following assumptions were made when developing the cost equation:

  1. The following appurtenant work was included in the general cost equation:

     - Pipeline modifications required to install the inflatable dam
     - Controls, instrumentation and telemetry

- Treatment Facilities, CSOTF, High Rate End-of-Pipe and Swirl Concentrators – Costs were expressed in million dollars per MGD treated for high rate end-of-pipe treatment units and swirl concentrators, and million dollars per MG treatment capacity for CSOTF construction. The following assumptions were made when developing the cost equation:

  1. Pumping, screening, disinfection and odor control facility costs, as required, were calculated separately from treatment facility costs.
  2. The following appurtenant work was included in the general cost equation:

     - Facility foundation including excavation, bedding and backfill
     - Baffles and weirs
     - Flushing system
     - Instrumentation, controls and telemetry
     - Control building
     - Ancillary piping
     - Valves and internal piping

- Disinfection – Costs were expressed in million dollars per MGD flow. The following assumptions were made when developing the cost equation:

  1. Disinfection facilities were typically required as appurtenant features to other CSO treatment methods that release treated CSO to receiving waters. Disinfection costs were calculated separately from these control technologies.

2. Disinfection cost equations were based upon peak flow ranges of less than 200 MGD and of greater than 200 MGD.

3. The following appurtenant work was included in the general cost equation:

    - Appurtenant piping and valving
    - Tanks, mixers and feed pumps
    - Instrumentation, controls and telemetry
    - Control building

- Screening - Costs were expressed in million dollars per MGD of flow screened. The following assumptions were made when developing the cost equation:

    1. Screening facilities were motorized, self cleaning units.
    2. Screening facilities were typically required as appurtenant features to other CSO control methods such as pump stations, storage tanks, tunnels and various treatment methods. Screening costs were calculated separately from these control technologies.
    3. The following appurtenant work was included in the general cost equation:
        - Instrumentation, controls and telemetry
        - Control building

- Odor Control – Costs were expressed in dollars per CFM of treated air flow. The following assumptions were made when developing the cost equation:

    1. Odor control facilities were sized for six air changes per hour.
    2. Odor control facilities were typically required as appurtenant features to other CSO control methods such as pump stations, storage tanks, tunnels and various treatment methods. Costs were calculated separately from these control technologies.
    3. The following appurtenant work was included in the general cost equation:
        - Instrumentation, controls and telemetry

- Control building(s)

Operation and Maintenance Costs. The operations and maintenance costs consist of annual labor, equipment and materials required to operate and maintain the CSO control facilities. The O&M cost equations were typically functions of the design flow rate (in MGD) and the duration time (in hours per year) that the facility is in operation. O&M costs typically accounted for periodic inspections and clean-ups after storm events, but did include full-time staffing between events.

COST ESTIMATING APPROACH

Costs for CSO alternatives are presented in the form of capital, O&M, salvage, and the associated net present worth costs. An effective discount rate of 6.625% was used for computing net present values for the alternatives development based on the Fiscal Year 2007 effective rate from the PaDEP. Net present worth O&M is computed in accordance with Engineering Economic Analysis, Newman, 1983.

The present worth factor of an annual O&M cost is:

$$\frac{P}{A} = \left[\frac{(1+i)^n - 1}{i(1+i)^n} \right]$$

where:

- P = Present worth of annual O&M cost
- A = Annual O&M cost
- i = Interest rate
- n = Number of interest periods in years

This factor $\left(\frac{P}{A}\right)$ multiplied by the annual cost (A), results in the Present Worth Cost as shown below:

$$\text{Present Worth} = \left(\frac{P}{A}\right) \text{ x A}$$

The present worth factor of an individual periodic O&M cost is:

$$\frac{P}{F} = (1+i)^{-n}$$

where:

- P = Present worth of periodic O&M costs
- F = Future sum to be paid
- i = Interest rate
- n = Number of interest periods in years

This factor $\left(\frac{P}{F}\right)$ multiplied by the periodic future cost (F), results in the Present Worth Cost as shown below:

$$\text{Present Worth} = \left(\frac{P}{F}\right) \text{ x F}$$

Present worth factors of periodic costs are presented in Table 1.

Table 1. Present Worth Factors of Annual $\left(\frac{P}{A}\right)$ and Future $\left(\frac{P}{F}\right)$ Cost

NUMBER OF YEARS (n)	DISCOUNT RATE (i) = 6.625%	
	$\left(\frac{P}{A}\right)$	$\left(\frac{P}{F}\right)$
5 years	**4.142**	**0.726**
10 years	**7.147**	**0.527**
20 years	**10.910**	**0.277**
30 years	**12.891**	**0.146**
40 years	**13.934**	**0.077**
50 years	**14.484**	**0.040**
60 years	**14.773**	**0.021**
70 years	**14.925**	**0.011**

The anticipated service lives of facilities were accounted for when assessing costs. Facility usage and construction qualities were factors that varied with the useful life of a facility. For planning purposes, specific durations were assigned to various facility types and are presented in Table 2**.** If the service life of a facility was not provided, a duration of 40 years was used, consistent with typical engineering practice.

Table 2. Service Life of Facilities

COMPONENTS	SERVICE LIFE (YRS)
Wastewater Conveyance Structure	**70**
Storage Structures	**50**
Other Structures	**50**
Process Equipment	**20**
Supplementary Equipment (Mechanical equipment, instrumentation controls, electrical generating facility)	**20**

The present worth computations considered the salvage value associated with the capital cost. This was especially critical when the service life of a facility far exceeded the planning period duration. Salvage value was computed by straight-line depreciation. This was achieved by multiplying the initial capital cost at the end of the planning period by a factor generated by dividing the planning period duration by the service life. In equation form:

Salvage Value = (Capital Cost) x (Service Life - Planning Duration)/(Service Life)

Land was considered permanent and had a salvage value equal to its original cost.

Annual O&M costs were brought to present worth by multiplying the annual cost by 10.910. This factor was determined using the 6.625 percent discount rate.

REFERENCES

The equations for capital and O&M costs for the various CSO control technologies described herein were derived from the following sources:

- Southerly District Combined Sewer Overflow Phase II Facilities Plan, Metcalf & Eddy in association with Wade-Trim, March 2002. Prepared for the Northeast Ohio Regional Sewer District.
- Evaluation of Planning Level Estimates of Probable Construction Cost, Metcalf & Eddy in association with Montgomery Watson, December 2006. Prepared for the Northeast Ohio Regional Sewer District.
- Contract CS-1158, Solution Element No. C04 – Sewer Separation, September 21, 1995. Prepared for the Detroit Water and Sewerage Department.
- Cost Estimating Procedures for Raw Sewage Overflow Control Program, CDM, April 23, 2004. Prepared for the City of Indianapolis Department of Public Works.
- Best Practices for the Treatment of Wet Weather Wastewater Flows, WEF, 2002

Facility costs were highly variable for each CSO control method due to site-specific factors such as location, depth, support facilities, and ease of construction. Based on the variability in the cost sources and the level of project development, it was estimated that the cost equations represent an accuracy of ± 30 to 50 percent. These are classified as Class V Estimates and are typical for planning level estimates. Typically, 30 percent accuracy is expected, and the additional 20 percent variability reflects unpredictability of construction costs due to site-specific issues. As details of the facilities planning alternatives are identified during future efforts, cost estimates must be refined to be more representative of actual conditions.

Capital and O&M equations were adjusted to an Engineering News Record Construction Cost Index (ENR CCI) of 7780, which corresponds to Pittsburgh area construction costs for January, 2007.

Table 3 presents the cost equations and/or assumptions used for developing both Construction and O&M costs.

TABLE 3. CONTROL TECHNOLOGY COST EQUATIONS			
Control Technology	**Cost Equations and Assignments**		**Comments**
	Construction ($)	**O&M ($/yr)**	
Source Controls			
Trenchless Rehab	$/LF = 11.976D $^{0.8633}$		D = Diameter (Inches)
Collection System Controls			
Open Cut Sewers			
<16' Deep	$/LF = 0.0956D ^{2} + 4.5784D + 200.71		D = Diameter (Inches)
>16' Deep	$/LF = 0.1822D ^{2} + 2.32423D + 305.84		
Sewer Separation			
Urban Areas	$/Acre = 200000A		A = Area (Acres)
Suburban Areas	$/Acre = 150000A		
Interceptor Connections	$/EA = -3.0814D ^{2} + 1300.3D + 59810		D = Diameter (Inches)
Regulator Structures			
New Structure (Static)	$/EA = $642,000 Each		
New Structure (Automatic)	$/EA = $1,285,000 Each		
New Regulator	$/EA = $60,000 Each		
Modify Existing Regulator	$/EA = $39,000 Each		
Pump Station			
<10 MGD	MM$/MGD = -0.0055Q ^{2} + 0.2032Q + 1.3248	$ = 18797Q $^{0.6681}$	Q = Flow Rate (MGD)
>10 MGD	MM$/MGD = 0.2534Q $^{1.0047}$		
Force Main	$/LF = 0.0419D ^{2} + 7.5573D + 113.76		D = Diameter (Inches)
Storage Facilities			
Tunnel			D = Diameter (Feet) L = Tunnel Length (Feet) S = Number of Shafts 5000 LF inspected / 8 hrs, 6 man crew 5 hrs / shaft
Rock	$/LF = 9.6799D ^{2} – 77.79D + 2078.2	$ = (200*8*L) / 5000	
Soft Ground	$/LF = -4.8635D ^{2} + 286.26D + 378.90	$ = (603.3*5*S) + 150000	
Storage Tank			V = Volume (MG) E = CSO Events / Year C$ = Construction Cost 8 hrs / event, 3-man crew
Above Grade	MM$/MG = 0.7899V $^{1.0899}$	$ = (76.8*T*E) + (0.0025*C$)	
Below Grade	MM$/MG = 2.6177V + 0.9141		
In-Line Storage	$ = 216.18D ^{2} - 16119D + 963005		D = Diameter (Inches)

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TABLE 3. CONTROL TECHNOLOGY COST EQUATIONS			
Control Technology	**Cost Equations and Assignments**		**Comments**
	Construction ($)	**O&M ($/yr)**	
Treatment Facilities			
Sedimentation Basin	$MM\$/MG = 0.1853V^2 – 0.1504V + 16.401$	$\$ = 112.5Q$	Q = Flow Rate (MGD)
High Rate End of Pipe Treatment	$MM\$/MGD = 0.0001Q^2 + 0.156Q + 1.2013$	$\$ = 23292Q^{0.5881}$	Q = Flow Rate (MGD)
Swirl Separation/Vortex	$MM\$/MGD = 0.3019Q^{0.611}$	$\$ = 112.5Q$	Q = Flow Rate (MGD)
Disinfection <200 MGD >200 MGD	$MM\$/MGD = -0.00005Q^2 + 0.0214Q + 0.3373$ $MM\$/MGD = 0.1039Q^{0.5993}$	$\$ = 16080Q^{0.6092}$	Q = Flow Rate (MGD)
Screening	$MM\$/MGD = 0.0463Q + .04123$	$\$ = 0.1825Q^2 + 82.896Q + 7435.5$	Q = Flow Rate (MGD) Assumes up to 10 CSO events / year
Odor Control	$\$/CFM = 0.0006C^2 – 1.8577C + 171423$		C = Capacity (CFM)
NOTE: Cost formulas updated to ENR Index for Pittsburgh for January 2007 (7880)			

7.0 Existing Water Quality Information

7.1 Introduction

One of the criteria for evaluating the effectiveness of alternative long term control plans is to assess the water quality benefits in the receiving waters that would be produced by the plans. It is therefore important to clearly define the existing water quality conditions, which would form the baseline for which potential benefits can be referenced.

Establishing the baseline water quality condition of the receiving waters involves collating and understanding of the available chemical, physical, and biological water quality parameters during both dry and wet weather conditions. It also includes defining data gaps, and developing water quality monitoring and sampling plans to fill in the gaps. The purpose of this section is to document the existing water quality data within the boundaries of the City of Pittsburgh. This includes data from different agencies, communities connecting to the City's system, and Stakeholders. Some of the identified data gaps are reported in this section while the proposed sampling program to fill in the gaps is presented in the following Section 8 of this report.

7.2 Existing CSO Discharge Water Quality

There are many CSO diversion chambers located within the City of Pittsburgh limits. The diversion chambers separate excess flow from the combined system that eventually flows into the Allegheny County Sanitation Authority (ALCOSAN) system for treatment. The excess flows are often discharged directly (without treatment) into nearby rivers and streams. CSO discharge is generally recognized as a major source of water pollution. The Allegheny County Health Department (ACHD) often notifies the general public, through their River Water Advisories, of health concerns during and after rainfall when the river water is considered unsafe for direct body contact.

Recent CSO discharge data for this area is not available. Gibson et al., 1998, reported a range of fecal coliforms of between 3,000 to 85,000 CFU/100ml for CSO end-of-pipe measurements at one CSO structure on Saw Mill Run. In the ALCOSAN CSO Bacteria sampling of August 1994 (reported by the Third Party Review of the ALCOSAN Regional

Long Term Wet Weather Control Concept Plan), fecal coliform counts vary from approximately 10^5 to 10^7 CFU/100ml.

7.3 Existing Receiving Water Quality Data

7.3.1 General Description of Receiving Rivers and Tributaries

The principle receiving water bodies within the PWSA study area include the three major rivers in the City of Pittsburgh: the Allegheny River, the Monongahela River, and the Ohio River. The Ohio River is formed by the confluence of the Allegheny and Monongahela Rivers. The Allegheny and Monongahela River watersheds are the two major basins that contribute to the receiving waters of the PWSA area. The two watersheds have a total drainage area of 13,151 square miles. Figure 7-1 identifies these water bodies within the City of Pittsburgh limits, including the major tributaries.

Allegheny River: The Allegheny River is 325 miles long. Its source is at a spring near Coudersport, Pennsylvania. The river flows northward into western New York, and then heads back south to Pennsylvania. The river has an average gradient of approximately three feet per mile. The U.S. Army Corps of Engineers (USACE) constructed eight locks and dams on the Allegheny River. The closest Lock and Dam to the City of Pittsburgh is 6.7 miles upriver from its mouth at Pittsburgh across from Sharpsburg, Pennsylvania. Approximately 4.2 million tons of freight is moved through the locks and dams along the Allegheny River annually. Washington's Landing, located on the Allegheny River approximately 2 to 3 miles downriver of the Ohio River, is within the City of Pittsburgh limits. In general, the Allegheny River valley supports only limited industry. During good weather more pleasure boats use the Allegheny River compared to its neighboring industrial rivers - the Monongahela and Ohio - since it flows through open country with postcard scenery and good fishing. The mean annual average flow is 19,724 cfs.

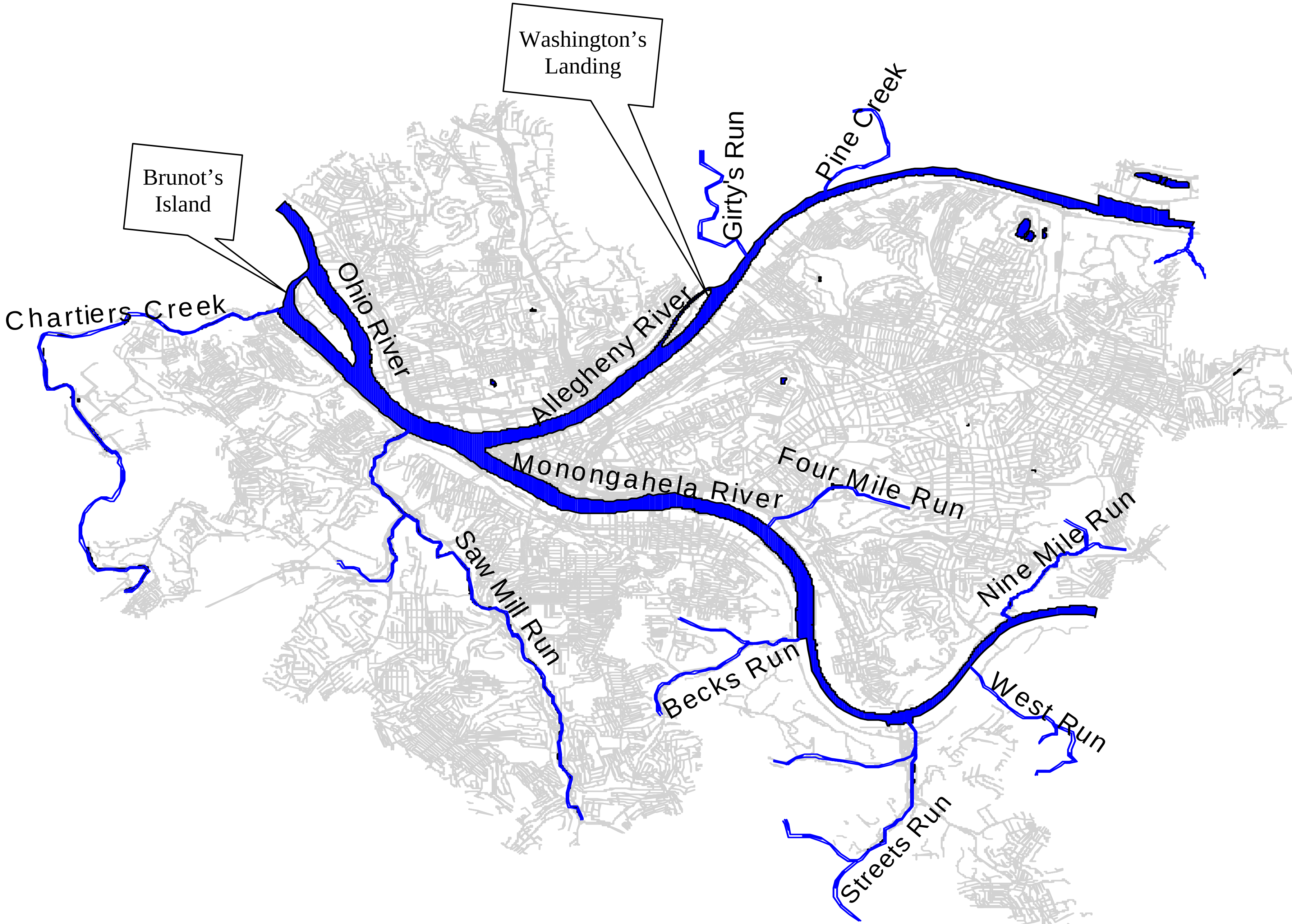

Figure 7-1: Major Rivers and Streams

Monongahela River: The Monongahela River is 116 miles long. Its headwaters begin near Fairmont, West Virginia. The river flows north towards Pittsburgh. The Monongahela River drains about 7,340 square miles of Maryland, Pennsylvania, and West Virginia. The USACE constructed nine locks and dams on the Monongahela River. The closest Lock and Dam to the City of Pittsburgh is Lock and Dam #2 in Braddock, Pennsylvania, which is outside of the City limit. The USACE is currently undergoing major renovation and construction works in the lower Monongahela River. Approximately 19 tons of freight is moved through the locks and dams along the Monongahela River annually. In general, the Monongahela River supports more industry than the Allegheny River. The river is also used for fishing and recreational boating. The mean annual average flow is 12,588 cfs.

Ohio River: Ohio River is 981 miles long and is the drinking water source for more than 3 million people. The Ohio River flows northwest, then generally southwest and then discharges into the Mississippi River at Cairo, Illinois. The river is a major tributary of the Mississippi River and contributes more water than the Missouri River does. The Ohio River basin covers approximately 204,000 square miles. There are several locks and dams on the Ohio River; the closest to the City of Pittsburgh is the Emsworth Lock and Dam. This lock and dam is located 6.2 miles downriver from Pittsburgh; it crosses both sides of Neville Island. Over 230 million tons of cargo is transported on the Ohio River annually. Brunot's Island, located on the Ohio River, is within the City of Pittsburgh limits. The mean annual average flow is 33,450 cfs.

Streams and Tributaries: There are several tributaries that flow into the three major rivers. The major ones that flow through the City of Pittsburgh include Chartiers Creek, Saw Mill Run, Beck's Run, Streets Run, Four Mile Run and Nine Mile Run. The characteristics of these selected streams are summarized in Table 7-1.

Table 7-1: Characteristics of Major Streams and Tributaries in the Pittsburgh City
(Information obtained from 3R2N – Stream Restoration and Daylighting)

Watershed	Tributary System	Stream Miles	Total Acres	Land Use by Percentage				Designated Use *	Stream Health Impairment
				Forested	Residential	Industrial	Impervious Surfaces		
Chartiers Creek	Ohio	363.52	60,707	42.2	24.9	1.7	11	WWF	Slight
		Point of Interest:	Crafton Golf Course						
Saw Mill Run	Ohio	61.61	43,028	22.7	66.8	0.3	23	WWF	Severe
		Point of Interest:	Brookline Park, McKinley Park, Mt. Washington Park, and Vabash Park						
Streets Run	Monongahela	34.4	6,437	45.1	38.5	1.6	12	WWF	Severe
		Point of Interest:	Highland Park						
Nine Mile Run	Monongahela	20.1	3,887	27.2	60.4	0.8	27	TSF	Severe
		Point of Interest:	Frick Park						
Four Mile Run	Monongahela	11.93	2,290	14.8	71.6	3.3	31	WWF	Severe
		Point of Interest:	Schenley Park						
Becks Run	Monongahela	7.58	1,627	40.5	54	0.2	17	WWF	Moderate
		Point of Interest:	Philip Murray Park						

* WWF = Warm Water Fishes
TSF = Trout Stocking

7.3.2 Water Quality Data of the Major Rivers

A number of government agencies were contacted for water quality data, including Pennsylvania Department of Environmental Protection (PADEP), 3 Rivers Wet Weather (3RWW), Allegheny County Health Department (ACHD), Allegheny County Sanitation Authority (ALCOSAN), US Army Corps of Engineers (USACE), Environmental Protection Agency (EPA) - Storet, Ohio River Water Sanitation Commission (ORSANCO), and US Geological Survey (USGS). Others include the connecting communities, 3 Rivers Second Nature (3R2N), and local watershed groups.

Available receiving water quality data for the Allegheny, Monongahela and Ohio Rivers, and tributaries (discussed in Section 7.3.3) was obtained primarily from four of the agencies referenced above. These agencies are the USGS, 3R2N, ORSANCO, and USACE (Pittsburgh District). Additional data was indirectly obtained from ALCOSAN from the report on the Third Party Review of the ALCOSAN Regional Long Term Wet Weather Control Concept Plan. The known existing water quality data locations for the rivers and tributaries are shown in Figure 7-2.

USGS DATA

The USGS data is documented in the USGS Water Year Annual Reports for 2001 and 2002 with the Fecal–Indicator Bacteria Project Reports dated October 2000 to September 2001 and October 2001 to September 2002, and contained within the respective annual report. A copy of each of these two reports is available from their website www.usgs.gov. The Fecal-Indicator Bacterial Project involves collaboration between the ACHD, ALCOSAN, 3RWW and USGS. The purpose of the study is to assess the impact of fecal-indicator bacteria during the summer months on the water resources of the Three Rivers in Allegheny County. Water-quality sampling and river discharge measurements were conducted during dry and wet weather conditions for five sites in 2001 and seven sites in 2002. Two of the five sites in 2001 are located within the City of Pittsburgh watershed, while three of the seven sites in 2002 are within the City. The three sites include the Allegheny River at the 9th Street Bridge at Mile Post (MP) 0.7, the Monongahela River at the Smithfield Street Bridge (MP 0.8) and the Monongahela River at South Pittsburgh upstream of Becks Run (MP 4.5).

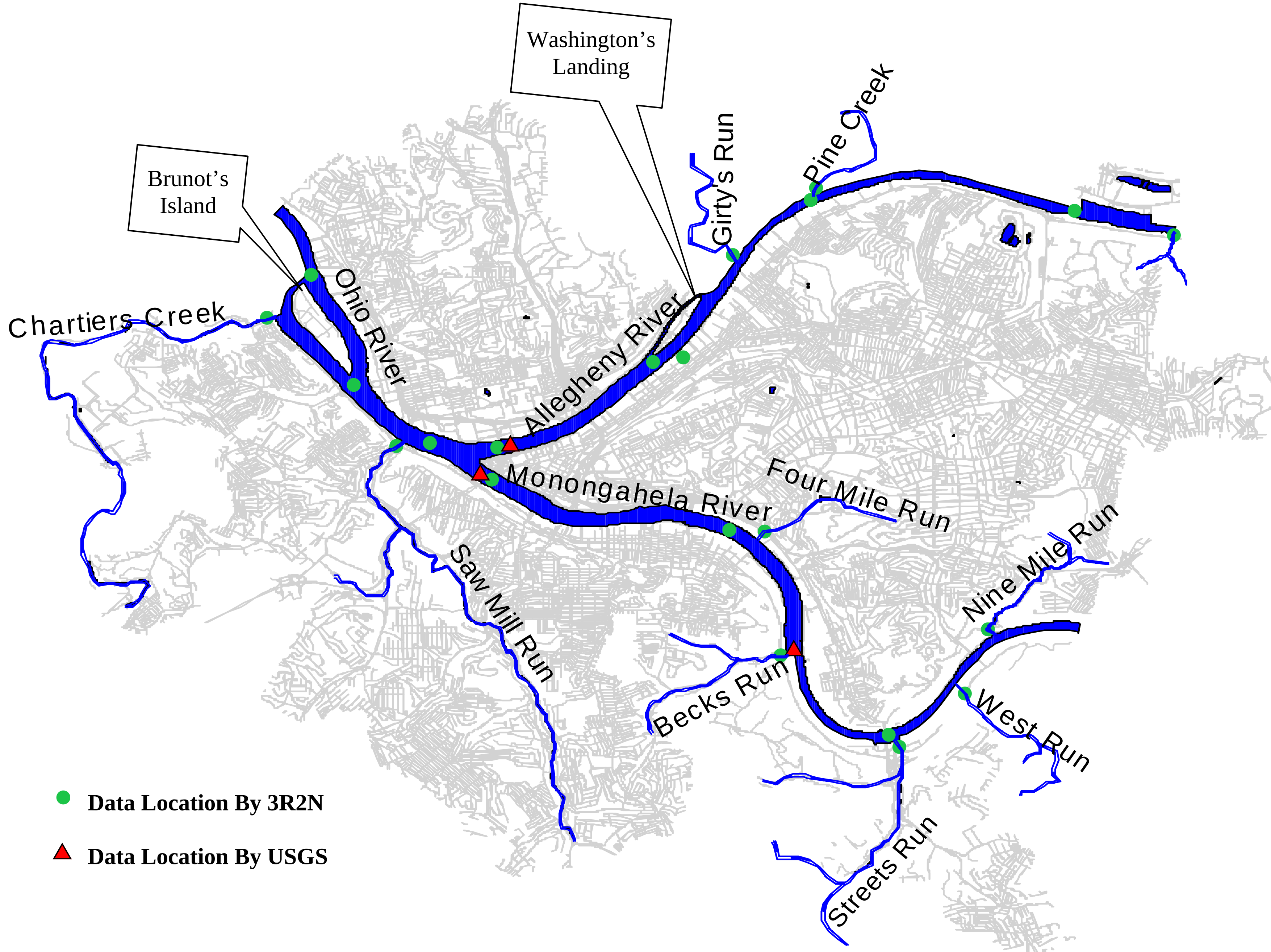

Figure 7-2: Existing Data Collection Locations

The USGS evaluated three types of fecal-indicator bacteria over the two year period: fecal coliform, E. coli and enterococci. The three fecal-indicator bacteria types were evaluated at the ACHD Laboratory. Three samples were taken at each location on each date to provide a cross sectional look at the water quality. This approach was utilized for 2 reasons: fecal indicator bacteria may occur in higher concentrations along river banks where tributary streams and combined sewer overflows discharge than in the middle sections of the large rivers, and the Three Rivers are wide and stream velocities low in the summer, high bacteria concentrations may occur for long distances along the banks downstream of discharge points due to incomplete mixing with more dilute sections of the river. The USGS results are summarized in Table 7-2.

Table 7-2: Summary of Dry and Wet Weather Fecal Coliform Data
(Data Collected by USGS)

Selected Sites Located in the City of Pittsburgh		2001		2002	
		Dry	**Wet**	**Dry**	**Wet**
Allegheny River at 9th Street Bridge (03049832)	Range of Actual Data	5 – 6,900	90 – 21,000	30 - 245	20 – 8,500
	Geometric Mean	116	1,286	94	405
Monongahela River at Pittsburgh (03085150)	Range of Actual Data	10 – 13,000	180 – 50,000	40 - 240	55 - 9,700
	Geometric Mean	239	1,690	94	570
Monongahela River at South Pittsburgh (03085120)	Range of Actual Data	-	-	15 - 140	165 – 3,100
	Geometric Mean	-	-	44	464

The above table combines all data, whether from the left bank, center channel or right bank. The low values often occurred within the channels while the higher concentrations were obtained from the banks. The data shows significant increase in fecal coliform counts from dry to wet weather conditions, indicating possible pollution from sewer overflowing into the rivers and tributaries. Also, the geometric mean for the dry weather condition is within the ORSANCO/PADEP benchmark of 200 CFU/100ml (in most cases), while the wet weather values greatly exceed the target level. It should be noted that the geometric mean data included in the table above is calculated from all the data collected for each year, which is different from the recommended procedure to compute the monthly geometric mean benchmark of 200 CFU/100ml established by ORSANCO and PADEP (See Section 7.4.2 below for information on the applicable standards).

The USGS also collected data on field parameters for pH, specific conductance, dissolved oxygen, and water temperature. These field parameters are within the applicable water quality standards. For example, the minimum dissolved oxygen for all the sites and for both years is 6.3 mg/L.

3R2N DATA

The 3R2N water quality study is a strategic program developed by the STUDIO for Creative Inquiry, in partnership with 3RWW, ALCOSAN, and the ACHD. The objectives were to reveal patterns and relationships between water quality, public use and the functioning ecosystems of the urban river systems in and around the City of Pittsburgh. The goal of the program is to reveal the dynamic nature of the water quality in the Allegheny County region by redefining water quality in the context of increased public access to the rivers and tributary systems, establishing a protocol that can be used by other agencies and organizations to develop a regional water quality baseline to make more informed decisions and comparisons to future water quality changes. The results of this study are presented in the Water Quality Phase I Report – Year 2000, with information confined to areas bounded by the three rivers at the following limits: Allegheny River at MP6.7, Monongahela River at MP11.2, Ohio River at MP6.2. These limits extend beyond the City of Pittsburgh. The river sampling points contained within the city limits include: Allegheny – MP0.18, MP2.26, MP4.57; Monongahela – MP0.23, MP2.82, MP5.66; Ohio – West End Bridge, Upstream of Brunot's Island and Downstream of Brunot's Island.

Part 2 of the 5 part program is presented in the Water Quality Phase II Report – 2001. Phase II is an extension of Phase I report along the Monongahela River from Lock and Dam #2 at MP11.3 near Braddock to the Allegheny County line at MP35. Phase III is a similar study extending along the Allegheny River from above Lock and Dam #2 at MP 7.4 to below

Kiskiminetas River at MP 28.9. Both Phases II and III studies extends outside of the subject Pittsburgh City sewer system. They are however useful in defining the water quality conditions of the rivers, upstream of the City boundaries.

The Water Quality Phase I Report - 2000 highlights multiple site sampling, analysis and comparison of water quality, in both dry and wet weather conditions along the three rivers. The objectives of the dry weather sampling was to understand how clean the water is in terms of pathogen indicator and to determine if it is clean over a broad sampling area. The objectives of the wet weather sampling was to understand how contaminated the water becomes in terms of pathogen indicators when it is raining, how quickly the water quality return to dry weather conditions and how consistent these changes are over a wide sampling area. Parameters monitored include pH, temperature, conductivity, dissolved oxygen, thermotolerant coliform, total coliform, E.coli, enterococci and fecal coliform. A copy of this report is available on their website 3r2n.cfa.cmu.edu.

The results of the fecal coliform sampling are summarized in Table 7-3 in terms of the geometric mean of all the data collected for the river.

Table 7-3: Summary of Fecal Coliform Bacteria for the three Rivers
Data from 3R2N Phase I Report – Year 2000

	Geometric Mean (CFU/100ml)	
Source	**Dry Weather**	**Wet Weather**
Allegheny	65	1,732
Monongahela	163	1,365
Ohio	119	1,518

The dry weather fecal coliform is within the ORSANCO/PADEP benchmark of 200 CFU/100ml, while the wet weather values greatly exceed the benchmark. Again, the geometric mean data included in the table above is calculated from all the data collected for the year, with sampling conducted once per month and no more than four samples collected per site, which is different from the recommended procedure to compute the monthly geometric mean benchmark established by ORSANCO/PADEP.

Despite the low values for the dry weather conditions, there were specific points along the Monongahela and Ohio Rivers with higher level of fecal coliform. The test sites exceeding the target level include the Monongahela River at MP0.23 (1,740 CFU/100ml) and MP5.66 (850 CFU/100ml), and the Ohio River at the West End Bridge (2,300 CFU/100ml) on the left descending bank just below Saw Mill Run. Two other locations of concern based on proximity to public access, are discussed in the report, however, they are outside the confines of the City of Pittsburgh system.

There are two most notable public access sites on the Allegheny River with elevated fecal coliform levels during wet weather conditions. They are located at MP2.26 on both the left descending bank, just below the back channel of Washington’s Landing, immediately downstream from the 3 Rivers Rowing Association and the right descending bank, just below Washington’s Landing near the Strip District and directly upstream from two marinas and a waterfront restaurant.

The report concludes the following two points: under dry weather conditions the rivers, for the most part, were within the benchmark of 200CFU/100ml (geometric mean) for fecal coliform in recreational waters and under wet weather conditions, all three rivers exceeded the benchmark for fecal coliform counts at all sampling points and remain elevated for days following a rainfall event. During rainfall, sewer overflows and storm water runoff contribute to contamination as well as other sources upstream, including tributaries.

ORSANCO DATA

ORSANCO conducts bacteria sampling at MP1.4 on the Ohio River. This location, which is within the City of Pittsburgh, is just above Brunot’s Island and downstream from Saw Mill Run. The Ohio River Bacteria Sampling Report includes data on fecal coliform and E.coli level measurements at three points, the left descending bank, middle of the river and the right descending bank, during the months of May through October of 2001-2002 and May through June 2003. In almost all cases, five samples were taken on different days in each month. The data makes no differentiation between samples taken in wet or dry weather conditions. The geometric mean for each month is reported for fecal coliform and E. coli. The results for fecal coliform are summarized in Table 7-4. A copy of the raw data can be obtained by contacting ORSANCO directly.

Table 7-4: Summary of Fecal Coliform Data for Ohio River at MP 1.4
Data Obtained from ORSANCO

	2001			2002			2003		
	Geometric Mean CFU/100ml			Geometric Means CFU/100ml			Geometric Means CFU/100ml		
MONTH	**Right**	**Middle**	**Left**	**Right**	**Middle**	**Left**	**Right**	**Middle**	**Left**
May	816	660	679	1457	233	770	369	386	397
June	499	508	383	638	454	522	613	615	670
July	308	303	297	275	359	256			
August	625	456	825	1253	1100	1255			
September	284	214	150	396	296	278			
October	251	213	271	421	421	474			

Overall, the monthly geometric mean for each of the sampling points exceeds the 200CFU/100ml benchmark. The raw data shows significant variations in the daily values for many of the months. For example, in May 2002, the fecal coliform counts on the right bank vary from 120 CFU/100ml on May 7th to 34,000 CFU/100ml on May 28th. It is likely that the higher concentration occurred under a wet weather condition. There is also significant variation in the data between the left bank, center channel and the right bank during many months, which may be due to the effects of Saw Mill Run discharges.

ALCOSAN DATA

Based on the Third Party Review of the ALCOSAN Regional Long Term Wet Weather Control Concept Plan, the ALCOSAN data were collected between 1993 and 1996 with no differentiation made between samples taken in wet or dry conditions. The results compared fecal coliform data for upstream (outside of ALCOSAN service area) with downstream (within the service area) sampling locations for Allegheny and Monongahela Rivers. Both upstream and downstream locations on the Ohio River are within the ALCOSAN service area.

The results indicate for the Allegheny and Monongahela Rivers, firstly, that the upstream fecal coliform levels for both rivers exceeded the water quality standards on a geometric mean and maximum level basis. Therefore, water quality compliance within the ALCOSAN service area cannot be attained through ALCOSAN CSO reductions alone. Secondly, that the downstream fecal coliform levels are greater than the upstream levels by a factor of about 10. This implies that discharges within the ALCOSAN service area have further impact on the receiving water quality. While CSO discharges are recognized as a principal source of the bacteria pollution, there may be additional contributory sources.

USACE DATA

The US Army Corps of Engineers, Pittsburgh District, has also collected water quality data on the three major rivers, but the data only has limited use. The data are collected once annually in the summer, and are not related to any rainfall events or CSO discharge. Data collected include temperature, dissolved oxygen, pH, metals and algae.

7.3.3 Water Quality Data of the Streams and Other Tributaries

3R2N DATA

The 3R2N data is documented in the Water Quality Phase I Report – Year 2000. The streams and tributaries evaluated include: Girty's Run and 32nd Street culvert which discharge to the Allegheny River; 4 Mile Run, Becks Run, Streets Run, West Run and 9 Mile Run which discharge to the Monongahela River; and Saw Mill Run and Chartiers Creek which discharge to the Ohio River. The report highlights single site sampling and analysis of water quality in dry weather conditions. Parameters monitored include total dissolved solids, ammonia, hardness, alkalinity, iron, aluminum, copper, E.coli and fecal coliform. A copy of this report is available on their website www.3r2n.cfa.cmu.edu.

The fecal coliform levels for the major tributaries are summarized in Table 7-5. The geometric mean data is calculated from all the data collected for the year, with sampling conducted once per month and no more than four samples collected per site.

Table 7-5: Geometric Mean of Fecal Coliform Data for Major Tributaries
2000 Recreational Season/Dry Weather
Data from 3R2N Water Quality Report Phase I - 2000

	Tributary	Geometric Mean Fecal Coliform (CFU/100ml)	Range of Raw Data Fecal Coliform (CFU/100ml)
Allegheny River	Girtys Run *	5,828	5,300 – 7,800
	Pine Creek *	5,647	620 – 23,000
	Sipes Run *	16,836	
	Heaths Run *	16	5 - 120
	Guyasuta Run *	208	90 - 610
Monongahela River	Streets Run	14,841	470 – 460,000
	Nine Mile Run	85	45 – 345
	Four Mile Run	353	230 – 635
	Becks Run	1,605	595 – 3,100
	West Run	9,095	2,000 – 23,000
	Homestead Run *	2,679	890 – 8,000
Ohio River	Chartiers Creek	381	80 – 2,900
	Saw Mill Run	2,580	785 – 14,000

* Outside of the City of Pittsburgh limits

The streams on the Monongahela River have higher fecal Coliform counts than the tributary streams on both the Ohio and Allegheny Rivers. The relative effect of the tributary streams on the amount of water flowing in the rivers is minimal, however, the mouth of the streams are of some concern due to the shallow waters, public access for fishing and limited opportunity for dilution. The results indicate higher fecal Coliform counts at the West End

Bridge sampling location just below Saw Mill Run and downstream from Chartiers Creek along the Ohio River, indicating problems in both streams, which do affect the main stem rivers within 50 feet of the bank. Because many of the tributary streams flow through parks and residential areas, public access may increase human exposure to waterborne pathogens.

ALCOSAN DATA

Based on the Third Party Review of the ALCOSAN Regional Long Term Wet Weather Control Concept Plan, the ALCOSAN data were collected between 1993 and 1996 with no differentiation made between samples taken in wet or dry conditions. The two relevant stream data presented in the report are Chartiers Creek and Saw Mill Run. The results also compared fecal coliform data for upstream (outside of ALCOSAN service area) with downstream (within the service area) sampling locations for the streams.

Similar to the monitoring data for the three main rivers, the data shows a significant increase in fecal coliform levels from the upstream to downstream locations. Also, the fecal coliform levels are approximately an order of magnitude greater than the main river data and exceed the water quality standards on a geometric mean and maximum level basis.

7.4 Water Quality Data Requirements

7.4.1 Designated Uses

The State Water Quality Standards are based on the following list of protected water uses:

- Aquatic Life – Cold Water, Warm Water, and Migratory Fishes; Trout Stocking
- Water Supply – Potable, Industrial, Livestock, and Wildlife Water Supply; Irrigation
- Recreation and Fish Consumption – Boating; Fishing; Water Contact Sports; Esthetics
- Special Protection – High Quality Waters; Exceptional Value Waters
- Other - Navigation

The rivers, streams, and tributaries in the City of Pittsburgh area have been designated as Warm Water Fishes (WWF) with the exception of Nine Mile Run, which is designated as

Trout Stocking (TSF). These designations represent the most sensitive or existing use the water quality standards are designed to protect.

7.4.2 Applicable Water Quality Standards

Several areas of the State's Water Quality Standards have been selected as critical components to be evaluated. These components may be affected by Combined Sewer Overflow discharges. The Water Quality Standards noted below are directly from Title 25, Pennsylvania Code Environmental Protection (25 PA Code).

Dissolved Oxygen. Section 93.7 of 25 PA Code includes minimum concentrations of dissolved oxygen, which must be met in surface waters of the state. Surface waters designated as WWF, must meet a minimum allowable level of 4.0 mg/l, with a minimum daily average of 5.0 mg/l. Surface waters designated as TSF, must meet a minimum of 5.0 mg/l, with a minimum daily average of 6.0 mg/l, between February 15 to July 31 each year; for the remainder of the year, a minimum allowable of 4.0 mg/l, minimum daily average of 5.0 mg/l shall be met.

pH. Section 93.7 of 25 PA Code has set the range of allowable concentration for pH to be from 6.0 to 9.0 inclusive. This standard is for both WWF and TSF designated water sources.

Total Dissolved Solids. Section 93.7 of 25 PA Code has set the allowable monthly average value for total dissolved solids to be 500 mg/l, with the maximum limit capped at 750 mg/l.

Bacteria. Section 93.7 of 25 PA Code has established bacteria exposure limits for Water Contact Sports. Measurements are in units of Fecal coliforms/100 ml.

- From May 1 through September 30, during the recreational season, a 30 day geometric mean fecal coliform must not exceed 200CFU/100ml. This mean is calculated on a minimum of five consecutive samples, with each sample being collected on different days, throughout a 30 day period.

- From May 1 through September 30, during the recreational season, no more than 10% of the total samples can exceed 400CFU/100ml, over a 30 day period.

For the remainder of the year, the 30 day geometric mean fecal Coliform must not exceed 2,000CFU/100ml. This mean is calculated on a minimum of five consecutive samples collected on different days, throughout a 30 day period.

7.5 Conclusions

The fecal coliform level for the three main rivers is often within the established limits during dry weather conditions, except at some selected sites that are just downstream of major polluted tributaries. Other water quality parameters, such as dissolved oxygen and pH, are often within acceptable limits during both dry and wet weather conditions.

The major concern for the three rivers is during wet weather, when there is elevated fecal coliform level, above the established limits for the designated uses. In addition, it often takes several days for some of the sites, especially the left and right banks, to return to the dry weather conditions.

In general, the available data can be used to define the baseline conditions for the water quality of the main rivers, except that the number of total data points from the various agencies is very small to make definite conclusions. Therefore, additional water quality data is recommended. The water quality data collection will focus on bacteria indicators, and coincide with the proposed flow monitoring program, as discussed in Section 8 of this report.

On the streams and tributaries, the most comprehensive water quality data are from the 3R2N. The available data indicate that water quality standards are not met during both dry and wet weather conditions. The stream conditions become significantly worse during wet weather. In the 3R2N report, fecal coliform counts were as high as 14,000 CFU/100ml on Saw Mill Run during dry weather, while Gibson et al. reported fecal coliform counts as high as 107,000 CFU/100ml on Saw Mill Run during wet weather. Other water quality parameters are within the state water quality standards, except for some selected sites such as Nine Mile Run which has high pH values.

Similar to the three rivers, the main problem with the available data is that the number of samples is small to form a conclusive opinion. Additional data for physical, chemical, and biological parameters is recommended, and to coincide with the proposed flow monitoring program.

For both the main rivers and streams, it is important to include sampling sites that are just upstream of the City of Pittsburgh limits, in other to define the baseline and maximum extent for which the water quality standards can be reached by the City of Pittsburgh efforts alone. Further discussions on site selection for sampling are provided in the following Section 8.

APPENDIX A

TECHNOLOGY DATA SHEETS

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SOURCE CONTROL: BEST MANAGEMENT PRACTICES

ALTERNATIVE: CATCH BASIN CLEANING

Classification: Source Control - Best Management Practices

Description: Catch basins are installed in combined sewer systems to capture grit and other solids prior to entering the drainage system. Catch basins are designed to trap sediment while storm water inlets are not. Frequent removal of accumulated deposits from catch basins is a method often proposed in CSO control programs to reduce the heavy "first flush" effect that these deposited solids have on storm water flows, and to help reduce sediment buildup in the sewers. Cleaning can be performed manually or by eductor, bucket, or vacuum.

Advantages:

- Maintains system efficiency
- Significant (20 to 30 percent) reductions in TSS and floatables are possible
- Reduces sediment & its associated pollutants from CSO generated by small runoff events

Disadvantages:

- Requires significant amount of maintenance coordination
- Vacuum and eductors are noisy, but generally cleaner than buckets
- Cleaning schedules may need to be adjusted for areas with traffic congestion
- Overall pollutant removals are generally low
- Will only reduce "first flush" effects
- Will not reduce fecal coliform bacteria
- Will not reduce frequency or duration of CSO, and may increase magnitude by increasing amount of water flowing into sewer, unless coupled with sewer optimization controls
- Required cleaning frequency (and therefore cost) is difficult to predict without conducting long term, site specific, catch basin debris accumulation studies.
- Must be applied system-wide for effectiveness

Applicability:

- To all catch basins
- Catch basin cleaning is highly dependent on local rainfall conditions. If an area experiences a high frequency of rain events then very frequent cleaning would be required to control runoff pollutants from catch basins. In areas with long periods of dry weather, catch basin cleaning is very effective in controlling runoff pollutants since the amount of pollutants in the catch basins at any one time is a significant fraction of the annual runoff yield.

ALTERNATIVE: STREET CLEANING

Classification: Source Control - Best Management Practices

Description: Although the major objective of municipal street sweeping is to enhance roadway appearance, the periodic removal of surface accumulations of litter, debris, dust, and dirt also reduces transport of such material into the sewer system. Common methods of street sweeping include manual sweeping, mechanical broom sweepers, and vacuum sweepers. Sweeping effectiveness is a function of several factors: sweeper efficiency, cleaning frequency, number of passes, equipment speed, pavement conditions, equipment type, portion of streets swept, litter control programs, and parking restrictions.

Advantages:

- Easily applied to highly developed urban areas
- Requires no new construction
- Provides visible aesthetic appeal actions by community
- Effective for removal of heavy metal, accumulation in streets
- Is reasonably effective for removing floatables, TSS and heavy metals resulting from atmospheric deposition

Disadvantages:

- Effectiveness is highly related to the type and quality of pavement
- Will not reduce fecal coliform bacteria
- Will not reduce the frequency, magnitude or duration of CSO
- Not easily applied to highly developed urban areas with limited parking
- Requires significant level of maintenance coordination
- Relative removal of BOD and suspended solids is small compared to the total CSO load

Applicability:

- Highly developed and established urban areas
- Curbed streets only

- Significant reductions in pollutant concentrations have been accomplished in climates that experience limited rain events and maintain a frequent street cleaning schedule. As the frequency of rain events increases the effectiveness of street cleaning decreases.

ALTERNATIVE: LITTER CONTROL

Classification: Source Control - Best Management Practices

Description: Litter Control regulations include ordinary litter as well as pet feces. The enforcement of anti-litter bylaws can help prevent litter such as paper, cans, cigarettes, etc. from reaching the street and, if not removed by street cleaning equipment, subsequently reaching a storm water discharge. Although litter ordinances do not appear to be effective water quality management tools, they can reduce the amount of trash collected at screening facilities, the quantity of floatables observed at outfalls, and sources of bacteria contributed by domestic pets.

By-law enforcement requiring owners to remove pet feces immediately when deposited on city streets, public parks, and other public and private property, would eliminate some of the fecal coliform bacteria contained in the runoff. Pet owners should also be encouraged to properly dispose of feces deposited on their own property.

Advantages:

- Low control cost of program
- Reduction of trash and floatables before entering the collection system
- Reduction of fecal coliform bacteria in receiving waters due to proper disposal of pet feces

Disadvantages:

- Enforcement of program is difficult
- Requires voluntary compliance

Applicability:

- System-wide

ALTERNATIVE: DEICER CONTROL

Classification: Source Control - Best Management Practices

Description: Street runoff from melting snow and ice, mixed with chloride salts, reaches receiving waters through one of three pathways: 1) transport to, and discharge from, local sewage treatment plants; 2) through storm sewer discharges; and 3) by dumping snow removed from streets into the receiving water. This loading can have a negative impact on the receiving water since snow deposits can contain sodium chloride, oils, suspended solids, and heavy metals.

Two options exist to mitigate the impact of deicers on receiving water. The first is to find an alternative substance with which to replace chloride salts, such as sand or cinders. The second is to modify salt storage and application procedures in order to minimize impacts.

Surface runoff protection and infiltration control measures are necessary near deicing storage facilities.

Advantages:

- Alternative deicers minimize damage to cars, bridges, and roadways caused by salt

Disadvantages:

- Enforcement of salt handling and storage techniques is difficult
- Abrasives, such as sand and cinders can become storm water pollutants (suspended solids)
- Alternative substances are more expensive and less effective
- Safety may be sacrificed with alternatives to chloride salt

Applicability:

- System-wide

ALTERNATIVE: FERTILIZER AND PESTICIDE CONTROL

Classification: Source Control - Best Management Practices

Description: Pesticides and fertilizers are controlled by removing these pollutants at their source, preventing them from entering receiving waters. The majority of fertilizers and pesticides, if properly applied, are reasonably innocuous to the environment, but should be applied sparingly and as a last resort. A recommended option for a municipality is to limit the use of fertilizers, pesticides, herbicides and other chemicals to uses consistent with their intended purpose, and provide appropriate considerations to their storage and distribution. Homeowners should also be encouraged to follow similar guidelines on private property.

Advantages:

- Programs can provide effective guidelines for fertilizer applications for public

Disadvantages:

- Enforcement of fertilizer/pesticide control is difficult
- Does not address some CSO pollutants of concern (ie: bacteria, solids)

Applicability:

- System-wide

ALTERNATIVE: HAZARDOUS MATERIAL CONTROL

Classification: Source Control - Best Management Practices

Description: Many communities have implemented programs to educate citizens about proper disposal of hazardous materials. This includes programs about use and disposal of fertilizers, herbicides, pesticides, used oil, and other materials that can have a detrimental effect on the environment.

Oil and grease are improperly disposed of frequently into storm sewers. The main pollutant source is do-it-yourself automobile oil changes, and used oil from service stations used for road oiling. Some communities support educational programs with more aggressive activities. One common practice is to provide a community wide drop-off date for hazardous materials such as solvents, oils, and paints. Used oil recycling centers have also gained popularity.

Advantages:

- Effective public information programs exist (oil recycling)
- Ease of implementation
- Possible water quality improvement

Disadvantages:

- Enforcement of hazardous material discharges is difficult
- Does not address some CSO pollutants of concern (ie: bacteria, solids)

Applicability:

- System-wide

ALTERNATIVE: INDUSTRIAL RUN-OFF CONTROL

Classification: Source Control - Best Management Practices

Description: Industrial and commercial runoff contributes significant amounts of pollutants such as grease, oil, and toxins to combined sewer systems. Areas of concerns are factories, gas stations, parking lots, and rail yards. Pretreatment of oil and grease is an effective control measure.

Advantages:

- Consistent with one of the nine minimum control measures cited in U.S. EPA's CSO control policy
- Regulatory structure in place through existing NPDES pre-treatment requirements
- Significant reduction of pollutants in runoff and spills discharged to sewer system
- Possible elimination of pollutant sources
- Sanitary sewer relief is an added benefit if storm flows are detained onsite

Disadvantages:

- Construction of treatment and/or storage facilities required
- Tends to be expensive and difficult to enforce

Applicability:

- System-wide

ALTERNATIVE: WATER CONSERVATION

Classification: Source Control - Best Management Practices

Description: Water conservation efforts include public education programs to promote conservation through the use of announcements and advertisements. Public involvement is a must if water conservation, source reduction activities and BMPs are to be effective.

Water conservation methods aim to reduce water usage, water supply requirements and wastewater treatment needs. There are a number of conservation methods, including distribution system leak detection and repair, mandatory alterations to buildings, industrial water re-use, installation of water efficient devices in homes, water use restructuring, and public education.

To decrease sanitary sewage flows, indoor water use must be reduced. Studies have proven that installation of water saving devices such as low flow toilets and showerhead controls effectively reduces wastewater flow in sanitary sewers. This reduction in sewage flow has been shown to have little effect on wastewater composition and transport characteristics. Reductions in domestic water usage will not affect the amount of solids being transported through the sanitary and combined sewer systems nor the amount of infiltration which is normally a significant component of the sewage flow.

Advantages:

- Informs the public and allows public involvement
- Reduction of sewage flows
- Conservation of energy
- Delaying of the possibility of capital works projects in the sewer system

Disadvantages:

- Implementation takes time, with little or no short term change (2 to 5 years) to treatment plant flows
- No effect on peak combined sewer flows

Applicability:

- Throughout sewershed

ALTERNATIVE: PUBLIC EDUCATION

Classification: Source Control - Best Management Practices

Description: Public education with respect to the proper uses of sewers, the impacts of discharges to sewers, and the various issues and constraints associated with available discharge alternatives, can greatly assist a government endeavoring to implement pollution control. Public education is always an important factor for a municipality. Not only does education promote good practices, it also keeps the municipality’s efforts to control pollution in the public's mind on a continuous basis.

Targeting school children is a particularly effective technique because educating the young about proper management of pollutants has long reaching effects. Children will make the difference in the future, and they will even put pressure on their parents to change their behavior or practices.

Advantages:

- Gain support for controversial alternatives
- Inform and communicate with the public

Disadvantages:

- Extensive effort over a period of time for the public to change its habits
- Takes years before the effect of pollution control education has a measurable effect
- Has limited success if not implemented correctly

Applicability:

- Community or watershed-wide

ALTERNATIVE: SEWER USE BYLAWS

Classification: Source Control - Best Management Practices

Description: Sewer use laws enacted by a community allow for the prohibition of unwanted discharges into collection systems. The laws also provide the community with an avenue through which illicit discharges can be stopped and costs for clean up and mitigation can be recovered.

Advantages:

- Provides consistently applied set of standards
- Specifically identifies requirements and penalties for failure to comply

Disadvantages:

- Requires manpower to enforce

Applicability:

- Community wide

ALTERNATIVE: SPILLS EMERGENCY PROGRAM

Classification: Source Control - Best Management Practices

Description: A Spills Emergency Program is a set protocol for the reaction to, and containment of, spills. They are developed by communities across department lines and include input from Engineering, O&M, Police, Fire and community managers.

Advantages:

- Provides consistently applied set of standards and procedures
- Identifies chain-of-command
- Provides prompts for the proper and required notification of outside agencies

Disadvantages:

- Requires strong manager to develop and maintain

Applicability:

- Community or agency wide

SOURCE CONTROL: INFILTRATION / INFLOW CONTROL

ALTERNATIVE: SEWER AND MANHOLE REHABILITATION

Classification: Source Control - Infiltration/Inflow Control

Description: Sewer/Manhole Rehabilitation is a method that involves repairs to the sewer connection system and manhole structures to minimize the volume of Infiltration/Inflow (I/I) through manholes, joints, and cracks from surface runoff and ground water infiltration. Sewered areas that experience significant infiltration from groundwater or riverwater into sewers and manholes are often indicative of sewers in need of repair, lining, or replacement. Such repairs include slip-lining, grouting, structural rehabilitation, and manhole I/I proofing systems.

I/I can account for a significant quantity of the flow being transported in a sewer system. I/I can increase treatment costs at the treatment facility by adding significant quantities of water of variable quality and reducing the efficiency of some treatment equipment.

Advantages:

- Increased availability for in-system storage capacity
- Increased efficiency of existing sewerage conveyance system
- Possible fewer overflow discharges to receiving waters
- No land requirements

Disadvantages:

- May not reduce or eliminate all CSO flows

Applicability:

- Collection system-wide

ALTERNATIVE: ROOF LEADER AND FOOTING DRAIN DISCONNECTION

Classification: Source Control - Infiltration/Inflow Control

Description: Roof leader and footing drain disconnection removes intentional discharges of clean water from the collection system. Roof leaders are disconnected and allowed to discharge over a yard or other pervious surface. Footing drains are connected to a sump pump that discharges onto the yard. Roof leaders are easy and cost-effective to disconnect and can generally per completed by the home owner. Footing drain disconnection requires tieing into the drain, either inside or outside of the house. This generally requires an experienced contractor or plumber.

Advantages:

- Infiltration/Inflow significantly reduced
- Reduces maintenance problems of gutters and footer drains
- Reduction of wet weather flow in sanitary pipe
- Relieve downstream flow load impacts
- Supply “free” water for gardening

Disadvantages:

- Expensive (footer drains)
- Can lead to ice where not well draining
- Disruptive to landscaping (footer drains)

Applicability:

- All combined sewers

ALTERNATIVE: CROSS CONNECTION REMOVAL

Classification: Source Control - Infiltration/Inflow Control

Description: Cross connections within the sewer system exist when there is a direct or indirect connection between the storm and sanitary sewer systems. A direct connection is exemplified in common trench systems where sanitary and storm pipes share a common dividing wall and manhole. Indirect connections are cracks or holes in the sanitary sewer system. Common methods for the identification of cross connections are: flow monitoring, manhole and pipe inspections, internal and external building inspections, smoke testing, dye testing. Testing programs are an efficient way of determining illicit connections such as connections of sanitary laterals and storm drains to storm sewers, but are very labor intensive. Monitoring of pollutant levels at storm sewer outfalls can be a deterministic tool for identifying areas containing cross-connections.

Advantages:

- Sanitary sewer relief provided by eliminating storm flow

Disadvantages:

- Extensive construction required, road and sewer replacement
- High relative cost
- Steps required to implement cross connections are not clear cut and are study specific.
- Often involves corrections on private

Applicability:

- In separate sewersheds where I/I is significant, tributary to CSO system
- Not applicable to designed combined systems

SOURCE CONTROL: STORM WATER MANAGEMENT PRACTICES

ALTERNATIVE: UPSTREAM STORMWATER STORAGE

Classification: Source Control - Storm Water Management Practices

Description: Storm water retention and detention ponds are common techniques used to control peak rates and volumes of surface runoff in areas served by separate storm sewers. Such ponds can be used within a combined sewer service area to control the rate of surface runoff entering the combined sewer collection system. Reduced flow rates within the combined sewers will result in interception and treatment of a larger portion of the flow, thus reducing the volume of CSO.

Advantages:

- Can achieve high levels of CSO volume reduction
- Detention reduces the peak flow rates, peak overflow rates and overflow volume
- Takes advantage of existing upstream natural and storm drainage systems could be used to their maximum capacity

Disadvantages:

- Siting of required storm water basins in developed upstream areas or steep terrain may be difficult
- Natural wetland ecosystems may not tolerate additional ponding
- Many basins are required for area-wide applications
- Some upstream detention may contribute to localized flooding (e.g., wet basements)
- Upstream storage may not be compatible with existing land use

Applicability:

- In upstream portions of the combined sewer service area where topography and land use permit the siting of surface storm water ponds

ALTERNATIVE: POROUS PAVEMENT

Classification: Source Control - Storm Water Management Practices

Description: Porous pavement consists of various surface treatments from concrete pavers to porous asphalt. Concrete pavers rely on the paver joints to provide the pervious area for infiltration. Porous asphalt technology involves installation of a pervious, open-graded asphalt wearing course over a base course with large void spaces. The base course functions as a detention reservoir. Rain then passes through the wearing course, collects in the void space of the base course, and ultimately drains away by natural infiltration. Porous pavement has been a suggested technique for areas such as parking lots, playgrounds, and lightly traveled roads. The effect is to reduce the amount of storm water runoff that enters the sewer system.

Advantages:

- Superior to conventional pavement in terms of traffic safety (increased skid resistance, less susceptible to hydroplaning
- Diversion of large amount of runoff volume into the soil
- Prevention of downstream soil erosion

Disadvantages:

- Groundwater contamination
- Restricted to areas of favorable conditions such as soil type, groundwater depth, land slope, and location with respect to water supply wells

Applicability:

- Where conditions are favorable

ALTERNATIVE: INFILTRATION TRENCHES AND BASINS

Classification: Source Control - Storm Water Management Practices

Description: Infiltration trenches are long, narrow facilities, while basins can take any other shape. For in situ infiltration to be effective, the ground water table must be sufficiently low and soil infiltration rates must be sufficiently high. This method encourages recharge of the groundwater table, removes a significant number of pollutants from the storm water, and can also assist in reducing peak flows in the system by acting as a source control.

Advantages:

- Fine particulates and soluble type pollutants are removed after exfiltrating through a trench
- Infiltration basins divert a large amount of runoff volume into the soil
- Trenches and basins lower stream velocities, which may reduce streambank erosion

Disadvantages:

- Coarse particulates are not removed by trenches and cause clogging
- Infiltration basins are not aesthetically pleasing
- Infiltration basins and trenches require routine maintenance to keep them clean
- Possible groundwater contamination
- Only applicable under favorable conditions (soil, groundwater depth, land slope)

Applicability:

- Where conditions are favorable for soil infiltration

ALTERNATIVE: EROSION AND SEDIMENTATION CONTROL

Classification: Source Control - Storm Water Management Practices

Description: Erosion and sedimentation control measures reduce the potential for eroded material to enter the sewer system and to the receiving waters. Erosion/storm water control measures can be required at construction sites and storage areas for salt, sand, and other materials comprised of particulates. At construction sites, control measures should include the maintenance of natural vegetation to the extent possible; the use of hay bales to filter runoff; the use of crushed rock or rip rap in drainage channels to help attenuate runoff; the covering of stockpiled materials; and the use of storm water sedimentation basins to attenuate runoff and provide solids deposition. At storage areas, stockpiled materials should be covered or located within shelters. It should be noted that storm water controls will require some of these procedures also.

Advantages:

- Encourages vegetation for an aesthetically pleasing environment
- Minimization of sediments entering sewer

Disadvantages:

- Does not address some of the CSO pollutants of concern
- Does not reduce CSO volumes

Applicability:

- System-wide

ALTERNATIVE: OVERLAND FLOW SLIPPAGE AND CATCH BASIN RESTRICTION

Classification: Source Control - Storm Water Management Practices

Description: Overland Flow slippage and catch basin restriction is a method of preventing storm water from entering the sewer system at a location by channeling the flow to an alternate destination. This is typically performed by altering the inlets to surface drains to block inflow and allow it to "slip" by. Storm water is detained on the surface of the streets during critical peak flows thus allowing more sewer capacity for the wastewater flows to the treatment facility.

Overland flow slippage is the method of routing storm water runoff overland to a drainage system that can accommodate the flow. This method could be classified as a minimal partial sewer separation. In a combined sewer area, catch basins contributing flow to the sewer are disconnected and new catch basins connected to a new storm sewer. Overland flow slippage uses the minimum number of catch basins that will maximize the overland flow routes. Instead of catch basins collecting runoff every block, the catch basins may be located every two blocks and flow contributed from both directions. Thus the new storm sewer does not have to be constructed in every block. Another method involves "slipping" the storm water flow directly to a receiving water rather than into the combined system.

Advantages:

- Relatively easy to alter the existing system
- Can be cost-effective in appropriate areas
- Maximizes use of existing sewer system
- Has potential CSO reduction effectiveness comparable to sewer separation
- Requires minimal construction
- Can be implemented without major construction costs

Disadvantages:

- Site specific – overland flow routes determine if control is feasible
- Requires sloping terrain
- Surface flow can create local nuisance conditions

- Increase in surface runoff pollutant loads may not achieve water quality goals
- Increase in surface runoff volumes may invoke storm water regulations
- Standing water in and around catch basins can increase debris and cleaning

Applicability:

- Most applicable in areas with adequate grade to enhance runoff or for flow diversion
- Site specific

ALTERNATIVE: PRIVATE PROPERTY STORAGE

Classification: Source Control - Storm Water Management Practices

Description: Private property storage collects rainfall from rooftops for use as a non-potable water source. Applications include yard, landscaping and garden watering, car washing, and summertime childrens' activities. Specific options include rain barrel collectors and "green roofs".

Advantages:

- Utilized "free" water
- Encourages infiltration through yard applications
- Decreases storm water load to receiving stream

Disadvantages:

- Sitting water attracts disease-carrying insects

Applicability:

- System-wide

ALTERNATIVE: STORM WATER PERMITTING

Classification: Source Control - Storm Water Management Practices

Description: Storm water permitting allows for the control of discharges into the storm water system from construction sites or other regulated sites.

Advantages:

- Specifies allowed and prohibited practices
- Provides for the inspection and control of construction site impacts
- Controls sediment and pollutant loading to receiving waters

Disadvantages:

- Requires staff to execute and enforce

Applicability:

- System-wide

ALTERNATIVE: URBAN FOREST STRUCTURE

Classification: Source Control - Storm Water Management Practices

Description: Urban forest structure reclaims the dynamic of the stream ecosystem by planting and encouraging the growth of trees, ground cover and small brush.

Advantages:

- Slows the flow of storm water into receiving water
- Allows for the absorption of storm water of plant life
- Provides a habitat for local species
- Aesthetically pleasing

Disadvantages:

- May require control on non-indigenous species
- May require animal control

Applicability:

- System-wide

ALTERNATIVE: STORM SEWER EXFILTRATION AND INFILTRATION SYSTEMS

Classification: Source Control - Storm Water Management Practices

Description: Storm sewer exfiltration and infiltration systems utilize constructed systems that resemble French Drains to control runoff. The exfiltration process allows runoff to enter local catch basins, where it then enters the storm sewer. At the adjacent downstream manhole, the flow drops into perforated pipes that are plugged at their downstream end. The water passes through the pipe perforations into a stone filled trench, and from there it seeps into the surrounding native soils. When the quantity of runoff exceeds the designed capacity of the perforated pipes, the water will flood the exfiltration system. At this point, the stormwater will begin to be conveyed via the conventional storm sewer pipe.

The infiltration process also allows runoff to be filtered through a perforated pipe into a stone filled trench. However, instead of exfiltrating into the surrounding native soils, the stormwater is collected again at the bottom of the trench by a smaller perforated drainpipe. It is then discharged back into the storm sewer system at the adjacent downstream manhole. Again, once the capacity of the first perforated pipe is exceeded, water will back up in the catch basin until it overflows into the conventional sewer. The exfiltration process allows runoff to enter local catch basins then enters the storm sewers. At the next downstream manhole the flow drops into two perforated pipes which are plugged at the downstream end. The water passes through the pipe perforations into a stone filled trench and from there seeps into the surrounding native soil. When the amount of runoff exceeds the designed capacity of the perforated pipes the water will backup in the perforated pipes towards the upstream manholes and overflow via the conventional storm sewer pipe. Bacteria and nutrients will pass through this system but sediment and heavy metals should be removed.

Advantages:

- Exfiltration - deals with first flush characteristics
- Exfiltration - rain events and snowmelt can be addressed since the piping system is located below the frost line

- Infiltration systems divert a large amount of runoff volume into the soil

Disadvantages:

- Exfiltration - typically installed in new developments. Established developments must undergo new construction of sewers and possibly roads, which lead to neighborhood disturbances such as noise.
- Infiltration will not improve the quality of water as much as exfiltration system
- New technologies not widely used and tested
- Coarse particulates are not removed by the perforated pipes and cause clogging
- Systems require routine maintenance to keep them clean
- Possible groundwater contamination
- Only applicable under favorable conditions (soil, groundwater depth, land slope)

Applicability:

- Most applicable in areas where storm water sources cause capacity problems and sewer system surcharging

ALTERNATIVE: WATER QUALITY INLETS

Classification: Source Control - Storm Water Management Practices

Description: Water quality inlets have become increasingly popular for use in controlling oil, grit, and hydrocarbon loadings that are generally associated with parking lot runoff. Inlets are only designed to store a fraction of the design storm, however they separate some of the course sediment, oil/grease, and debris in urban runoff. Fine grained particulate pollutants, such as silts, clay, and associated trace metals and nutrients are less likely to be removed. There are various types of specialized products that are included in this classification.

The Stormtreat system uses pre-treatment capabilities directing storm water through a multi-stage, total suspended solids removal system. A grit-filter bag to trap large floatables, a series of sedimentation chambers fitted with skimmers, and a gravel filter that traps smaller particles.

The STORMTREAT^{TM} System (STS), developed in 1994, is a storm water treatment technology consisting of a series of sedimentation chambers and constructed wetlands that are contained within a modular, 9.5 foot diameter recycled-polyethylene tank. Influent is piped into the sedimentation chambers where pollutant removal processes such as sedimentation and filtration occur. Storm water is conveyed from the sedimentation chambers to a constructed wetland where it is retained for five to ten days prior to discharge. Unlike most constructed wetlands for storm water treatment, the storm water is conveyed into the subsurface of the wetland and through the root zone. It is within the root zone that greater pollutant attenuation occurs through processes such as filtration, adsorption, and biochemical reactions.

Stormceptor is a storm water treatment device that removes oil and suspended solids. The Stormceptor structure consists of a lower chamber that traps oil and any liquid with a specific gravity less water and also suspended solids.

End-of-Pipe (downstream) Defender consists of a concrete cylindrical vessel with a sloping base and internal components. Raw liquid is introduced tangentially into the side of the cylinder and spirals down the perimeter allowing heavier particle to settle out by gravity and the drag forces on the wall and base. By the time the flow reaches the top of the vessel, it is virtually free of solids and the solids are stored in the base of the vessel.

Storm water Management's CSF is designed to treat storm water pollution utilizing a variety of filter media including organic processed deciduous leaf media, which as been demonstrated to remove oils, greases, soluble metals, sediment, total phosphorous and other pollutants form in storm water runoff from impervious surfaces.

Advantages:

- Stormtreat – 80 percent removal of Total Suspended Solids
- Detention facilities are not needed
- Cost effective for specific applications
- Easy to access
- Compatible with storm drain network
- Provides pretreatment of runoff
- Relatively small land requirements
- Accepts a wide range of flow rates

Disadvantages:

- New construction required
- Widespread application required for effective pollutant removal
- Frequent clean-outs required
- Provides primary treatment only
- Limited storm water and pollutant removal capabilities
- Difficulties in disposal of accumulated sediments
- Some products are relatively new and untested
- Does not significantly reduce volume or frequency of CSOs

Applicability:

- These structures are typically installed in storm sewers

COLLECTION SYSTEM: SEWER SYSTEM OPTIMIZATION

ALTERNATIVE: REMOVE BOTTLENECKS

Classification: Collection System - Sewer System Optimization

Description: Sewer system bottlenecks are locations in the sewer network where flow is restricted due to undersized pipes or blockages. These can be removed by localized replacement of the restriction or maintenance and repair of the blocked segment.

Advantages:

- Reduce the number of combined sewer overflows
- Relieve sewer surcharging and associated flood issues
- Provides additional flow capacity
- Relatively cost effective, site specific solutions
- Encourages proper maintenance of the collection system

Disadvantages:

- Design and construction necessary
- Study of downstream effects must be performed

Applicability:

- This technology can potentially be used at any bottleneck location.

ALTERNATIVE: SEWER CLEANING AND MAINTENANCE

Classification: Collection System - Sewer System Optimization

Description: Sewer cleaning (flushing) and routine maintenance are practices that maintain the sewer system at an optimum performance level.

By introducing a controlled volume of water over a short duration at key points in a combined sewer system, deposited sewage solids can be resuspended and transmitted to the dry-weather treatment facility before a storm event produces flows that carry them to a receiving water. Water for flushing can either be supplied externally (from a tanker truck, for example) or internally through manual or automatic detention.

Experience has shown that no significant gain in the fraction of load removed is achieved by repeated flushing at a single point, and that 70 percent of the flushed solids will quickly resettle downstream. However, significant pollutant reductions can probably best be accomplished by sequential flushing at key points in a downstream direction, to keep the suspended solids in motion.

Advantages:

- A sewer cleaning program can be implemented with little or no new construction
- Sewer cleaning helps to maintain self-cleaning velocity of at least 2 ft/s
- Maintenance can reduce dry weather discharges to receiving waters
- Consistent with one of the nine minimum control measures from U.S. EPA's CSO Control Policy
- Reduces CSO treatment needs during wet weather
- Increases the sewer's hydraulic capacity
- Delivers pollution to interceptors for treatment at the WWTP
- Can be automated, in combination with in-line storage
- Good (20 to 30 percent) removal of BOD and heavy metals with even higher removal efficiencies for organics and nutrients

Disadvantages:

- Requires a high level of management and coordination
- Labor intensive
- Automated flushing systems may become complex and installation may be difficult
- Will only reduce "first flush" effects in sewer
- Will not reduce frequency or duration of CSO, and may increase magnitude by increasing sewer capacity, unless coupled with sewer optimization controls.

Applicability:

- Combined sewer flushing is most applicable to flat sewers where pollutants accumulate and enough water can be surged to produce a significant "first flush" effect. Systems with velocity of 2.0ft/s or more are considered self-cleaning.
- Can be implemented throughout the entire collection system

ALTERNATIVE: POLYMER INJECTION (LINING/COATING)

Classification: Collection System - Sewer System Optimization

Description: Polymer Injection (lining/coating) improves the roughness coefficient values (reduction of friction) for the pipe, reduces infiltration, and improves structural integrity.

Advantages:

- Self-cleaning velocity inhibited with improved friction characteristics
- Improved roughness coefficient theoretically improves flow characteristics
- Typically used in small sanitary sewers

Disadvantages:

- Minimal benefits in combined sewers
- Generally reduce the size of the conduit and may have an effect on the flow capacity

Applicability:

- Small sanitary sewers with which velocity problems exist and sedimentation is an issue

COLLECTION SYSTEM: REGULATOR OPTIMIZATION

ALTERNATIVE: STATIC REGULATOR DEVICE IMPROVEMENTS

Classification: Collection System - Regulator Optimization

Description: Static regulator device improvements can result in the decrease or elimination of CSOs during wet weather events. These improvements can be achieved in many instances by simply raising the weir crest, provided there are no adverse upstream or downstream impacts. Often, a regulator can be eliminated or modified in conjunction with the construction of a relief sewer, replacement of a relief sewer, or replacement of a dry weather outlet with inadequate conveyance capacity. Static regulators are structures that have a fixed weir, and include side weirs, transverse weirs, leaping weirs and orifices.

Advantages:

- Low maintenance
- Overflow locations can be reduced or eliminated
- Improved water quality
- Minimal construction
- Can be cost-effective alternative if system has adequate conveyance capacity

Disadvantages:

- No real-time adjustability
- Adjusted regulators may impact existing collection system by increasing surcharging
- Side weirs have problems in accurately controlling flow
- The design of leaping weirs is usually a trial-and-error process involving computations of flow trajectory and percentages of flow captured at various weir settings. Thus, the leaping weir is not considered an effective regulator.
- If not properly analyzed, can create increased flooding and/or CSOs in other locations

Applicability:

- Static regulators can be used at any applicable regulator structure

ALTERNATIVE: SWIRL/HELICAL, PLUNGE & VORTEX ENERGY DISSIPATERS

Classification: Collection System - Regulator Optimization

Description: Swirl/Helical, Plunge and Vortex Energy Dissipater regulators allow dry weather flow to pass without restriction. During high flow, the regulator structure flow pattern is a vortex motion. This vortex motion limits the amount of peak flow reaching downstream segments of pipe thus utilizing potential storage in upstream sections of pipe. Major modifications to this system include the provision of positive venting to eliminate surge during initial start-up and to ensure smooth stabilized vortex action.

Advantages:

- Maximization of existing capacity of sewer system
- These regulators do not have moving parts and require no external energy supply since they operate exclusively with flow effects

Disadvantages:

- New construction involved
- May require minimal cleaning/maintenance

Applicability:

- Swirl/Helical and Vortex Energy Dissipator regulators are used at locations that overflow frequently in the sewer system

ALTERNATIVE: BENDING WEIR (GNA HYDROBEND)

Classification: Collection System - Regulator Optimization

Description: A bending weir is designed with the same flow capacity as a standard overflow, but is designed to overflow only when the maximum design water level is reached. The bending weir automatically adjusts itself to maintain a constant design overflow water level. In-system storage is achieved using a bending weir.

Advantages:

- Reduces volume and frequency of overflows
- First flush is kept in the system and eventually treated
- The GNA Hydrobend prevents backflow from water bodies
- Low maintenance

Disadvantages:

- Regulator structure housing may need to be modified for bending weir to be effective

Applicability:

- Can be evaluated for any existing regulator structure to minimize CSOs

ALTERNATIVE: DROP STRUCTURE OPTIMIZATION

Classification: Collection System - Regulator Optimization

Description: A drop structure is designed with the same flow capacity as the receiving conveyance system. Optimization of the structure minimizes air entrainment that can significantly increase of physical volume of the drop flow. Release of the air downstream and provide for unpleasant odors.

Advantages:

- Maximizes uses of existing infrastructure
- Minimizes odors
- Low maintenance

Disadvantages:

- Difficult to retrofit existing structures

Applicability:

- Can be evaluated for any existing regulator structure to minimize CSOs

COLLECTION SYSTEM: INTER-BASIN FLOW BALANCING/RELIEF

ALTERNATIVE: INTER-BASIN FLOW TRANSFER

Classification: Collection System - Inter-Basin Flow Balancing/Relief

Description: Basin transfer is a method of transferring flows from one sewerage basin to another location, such as to another interceptor or to another drainage basin. Basin transfer is implemented when the capacity of a basin's collection system is exceeded and the flow is routed to a location where additional capacity exists.

Advantages:

- Flood problems can be reduced
- Maximization of existing capacity

Disadvantages:

- New construction involving possible relief pipe or structure
- Maybe be a temporary solution if excess existing capacity is for future land development
- Applicable situations limited since sewerage systems are designed only to accommodate the flows generated in that drainage basin

Applicability:

- All basins with capacity/flooding problems with adjacent basin with excess capacity

ALTERNATIVE: RELIEF SEWERS

Classification: Collection System - Inter-Basin Flow Balancing/Relief

Description: Relief sewers are intended to provide additional storage and conveyance capacity to reduce surcharging and to transport wet weather flows. Relief is normally provided by constructing a new conduit parallel to the existing segment that requires relief, with the existing conduit remaining in service. The relief sewer may also function as a replacement conduit if the existing sewer is old or in poor condition. Relief sewer operation may be controlled by a weir that directs dry weather flow into the existing sewer. During wet weather, when the capacity of the existing sewer is exceeded, flow would pass over the weir into the relief sewer. Relief sewers may reduce the need for surface CSO control structures and may also provide an opportunity for rehabilitating aging infrastructure.

Advantages:

- Reduction in frequency and volume of CSOs
- Flood/surcharge problems can be reduced
- Relief sewer can serve as replacement to old conduit
- The need for surface structures is greatly reduced
- Provides an opportunity for updating aging infrastructure

Disadvantages:

- New construction required
- Can result in increased downstream flows and impacts

Applicability:

- Areas or sewers with capacity/flooding problems

COLLECTION SYSTEM: SEWER SEPARATION

ALTERNATIVE: COMPLETE OR PARTIAL SEWER SEPARATION

Classification: Collection System - Sewer Separation

Description: Sewer separation requires construction of either new sanitary sewers, or new storm sewers within the combined sewer service area. The existing combined sewers will then function as either sanitary or storm sewers, depending upon the design intent of the newly constructed sewers. Complete sewer separation is the only method by which wet-weather CSO can be totally eliminated since storm water and municipal wastewater are carried in two separate systems. However, removing the sanitary component from the wet-weather flow will not eliminate wet-weather pollution, since a substantial portion of the pollution load is carried by urban storm water runoff.

Sewer separation may be complete or partial. Complete separation attempts to exclude surface runoff from the sanitary waste stream; whereas partial separation attempts to remove most of the surface runoff from the combined system.

Partial separation is often used in communities where sanitary flow and roof drainage are served by common house connections making complete separation extremely difficult. It is most often accomplished by constructing a new storm sewer system to collect street and area drainage. Roof drainage and sanitary flow would be carried by the old combined collection system. Another type of partial separation is to separate a targeted pocket of combined area that has a substantial impact on CSO volume or overflow frequency.

For both complete and partial separation, some I/I remains in the sanitary system. In many cases, additional storage equalization facilities are required to alleviate peak capacity problems during wet weather events. Another type of partial separation is to separate a targeted pocket of combined area that has a substantial impact on CSO volume or overflow frequency.

Advantages:

- Eliminates or reduces CSO, by eliminating or reducing the combined sewer service area.

- Permanent solution
- Some urban amenity improvement potential is possible
- Negligible additional O&M requirements

Disadvantages:

- High capital costs
- May require equalization storage facilities in converted sanitary sewer
- Disruptive to community during construction
- May be impractical in downtown and high population density areas
- Requires significant right-of-way and new facilities
- Would take a long time to fully complete
- Converts tributary area from combined sewers to separate urban storm sewers and therefore only partially removes receiving water pollutant loads
- Increase in surface runoff may result in additional storm water requirements
- Velocities in remaining sewers may not be self-cleaning

Applicability:

- Best in areas of new construction
- Area wide where right-of-way is available

STORAGE: IN-LINE STORAGE

ALTERNATIVE: INFLATABLE DAMS

Classification: Storage - In-line Storage

Description: An inflatable dam is a rubberized balloon that can be inflated or deflated with air or water depending on sewer flow conditions. Dams are regulated automatically or from a master control center to prevent upstream flooding while maximizing system conveyance capacity.

Inflatable dams are commonly located at the end of an outfall line, the beginning of an outfall line, in an interceptor, or before a regulator. The associated applications may be for in-line storage, outfall control, backflow control, standard flow control, and flow diversion.

Advantages:

- Weir can be adjusted to reduce number of combined sewer overflows
- Operator has more control to store flows than fixed weirs
- Can be used as open /closed gates to direct flows from one conduit to another when weirs, sluice gates, etc. are not practical
- Automatically inflated/deflated to prevent undesired surcharging while maximize the use of available conduit storage
- Reasonably low cost and quick implementation
- Proven in harsh climates
- Limited above-ground structures
- Fits any conduit shape

Disadvantages:

- Requires careful maintenance and repair
- Control instrumentation required

Applicability:

- For use in a regulator structure, in an interceptor, or in an outfall pipe

ALTERNATIVE: MANUAL AND AUTOMATIC GATES

Classification: Storage - In-line Storage

Description: Manual and Automatic Gates are gates that are located on overflow pipes or interceptors. The gates are closed during dry weather and during wet weather can be controlled depending on upstream conditions. Position of the gates can be modulated by the operator depending on the desired results. A Reverse Taintor Gate is another type of gate that responds to the water level in the combined sewer or the hydraulic grade line in the interceptor.

Advantages:

- Gate can be adjusted to maximize in-line storage, thereby reducing the number of combined sewer overflows
- Operator has more control to store flows than for fixed weirs

Disadvantages:

- Routine maintenance required
- Malfunction of gate can result in flooding or dry weather discharge

Applicability:

- Recommended siting is generally on an interceptor or an outfall pipe

ALTERNATIVE: EXISTING UNUSED CONDUITS

Classification: Storage - In-line Storage

Description: The usage of Existing Unused Conduits is a technology which uses abandoned pipes as flow storage. This method involves using pipes probably taken out of the sewer system due to sewer upgrades and re-introducing them as a form of storage.

Advantages:

- No new construction involved
- Utilize existing pipes
- Cost effective
- Real-Time control capabilities can be added

Disadvantages:

- Abandoned conduit to be used for storage must be surveyed and investigated before introducing flow, especially the water levels so that flooding is not a concern
- Bulkhead must be removed and weir to be built for use

Applicability:

- Can be used wherever unused conduits exist within the system depending on analysis of water levels and possible flooding concerns

ALTERNATIVE: STATIC-FLOW CONTROL STRATEGIES

Classification: Storage - In-line Storage

Description: Static flow control includes those sewer system BMPs that maximize flow to the treatment plant while minimizing overflow, bypass, and flooding, using simple control devices to develop potential in-line storage. These flow control devices will usually, but not always, be associated with the combined sewer regulators and may include fixed weirs, orifices or static vortex controllers.

Advantages:

- Maximizes use of existing facilities
- Uses conventional technology
- Minimal maintenance and management requirements
- Inexpensive control devices
- Short implementation period

Disadvantages:

- Installation may be very difficult, especially in congested areas
- Minimum pollutant reduction is possible
- Hydraulic design can be demanding and expensive

Applicability:

- Flat sewers with excess capacity and limited flooding potential offer the best sites

ALTERNATIVE: VARIABLE-FLOW CONTROL STRATEGIES

Classification: Storage - In-line Storage

Description: Variable in-sewer flow control devices include sluice gates, bascule gates, and inflatable dams which may be closed to induce in-line storage and opened to dewater the stored flow. The purpose is the same as the static flow control devices; however, operation flexibility is increased and the risk of unwanted flooding is decreased. In general, the scale of these projects is larger than for the static control alternatives.

Sluice gates are flow control devices that can be controlled either locally or remotely in accordance with local or remote sensing and/or predetermined logic.

Advantages:

- Maximizes use of existing facilities
- Short implementation period
- Inexpensive control devices

Disadvantages:

- Requires new construction
- Pollutant reductions are not substantial
- Installation may be difficult, especially in congested areas
- Maintenance and active control is required
- Hydraulic design can be demanding and expensive
- Operations criteria need to be formulated

Applicability:

- Typically applicable to large trunk sewers only due to the scale of the control devices

ALTERNATIVE: REAL-TIME CONTROL STRATEGIES

Classification: Storage - In-line Storage

Description: Real time control includes design and installation of a network of rain gages, flow gages, level sensors, overflow detectors, and remote system controls such that all variable system components, including gates, inflatable dams, etc., can be operated from a central location during a storm event (i.e., in real time) to minimize overflow.

The feasibility, cost, and effectiveness of real time controls are sewer system specific. In-system storage techniques using various levels of flow control and instrumentation have been installed in numerous cities.

Advantages:

- Provides the most flexibility in controlling a large system
- May provide in-line storage in areas where static storage is infeasible
- Logical extension of existing system management
- Easier to operate variable flow controls from a central location
- Responsive to variable demands placed on the system by uncertain rainfall events
- Moderate implementation period

Disadvantages:

- Requires considerable training for personnel to manage control systems
- Maintenance needs for monitoring equipment and controls higher
- Operational control strategies may be complex
- Design can be demanding & expensive; requires detailed, accurate data on entire system
- Long duration / low intensity rainfalls can be controlled better than short duration / high intensity storms

Applicability:

- Large collection and interceptor systems where there is significant in-line storage potential that cannot be developed by static or variable flow controls alone

STORAGE: SUBSURFACE STORAGE

ALTERNATIVE: TUNNEL STORAGE

Classification: Storage - Subsurface Storage

Description: The deep tunnel alternative provides consolidated off-line storage in tunnels often excavated in bedrock below the sewer system and other existing utilities. A complete deep tunnel system usually includes four main components:

- Near surface conduits to consolidate the flow from several outfalls
- Drop shafts to convey the consolidated flow to the tunnels
- Deep tunnels to store the flow and interconnect the drop shafts
- One or more pumping stations to transfer the stored CSO to treatment

Advantages:

- Minimal land requirements and need for surface facilities
- Less temporary construction impacts than many other storage alternatives
- Less permanent community impacts than many other storage alternatives
- Significant reduction in CSO volume, frequency, and magnitude
- Large storage capacities can be developed for high levels of CSO capture
- Centralized storage system for capture of CSO wherever it occurs in the service area
- Utilizes existing wastewater treatment facilities, including outfalls
- Dry-weather CSOs from regulator malfunctions eliminated for captured outfalls

Disadvantages:

- Significant construction required
- Near surface consolidation system can be difficult to construct
- Significant capital cost for consolidation, drop shafts, and pump-out facilities

Applicability:

- Most effective when implemented area-wide

ALTERNATIVE: CLOSED CONCRETE TANKS

Classification: Storage - Subsurface Storage

Description: Closed concrete tanks are generally constructed below grade and provide a completely enclosed unit for the storage of captured CSO. Such tanks must be equipped with maintenance access, aeration facilities, and washdown or sediment flushing equipment.

Advantages:

- Can be located in relatively high intensity land use areas
- Significant reduction in CSO volume, frequency, and magnitude
- Provides effective CSO storage
- Some urban amenity improvement potential is possible
- Multiple land use is possible. For example, the area above underground, closed concrete storage tanks can be used for open park land or for parking lots
- Closed concrete tanks can be distributed throughout the combined sewer service area

Disadvantages:

- Can be difficult to site facilities near residential or high use recreational areas
- Closed concrete tanks are expensive, relative to open tanks and earthen basins
- Requires large pumping facilities to treatment systems
- Larger area of construction disruption than tunnel

Applicability:

- Areawide, except perhaps for highly developed downtown areas

ALTERNATIVE: STORAGE AND CONVEYANCE CONDUITS

Classification: Storage - Subsurface Storage

Description: Storage conduits are similar to traditional dry-weather wastewater interceptors except that they tend to be much larger. The function of these conduits is to: (1) provide the required CSO storage, (2) consolidate several (or all) combined sewer outfalls, and (3) provide conveyance capacity. In general, such systems would be constructed downstream from the existing combined sewer regulators and below ground level. One or more pumping stations may be required to dewater the storage conduit(s) after a wet-weather event.

Advantages:

- Provides a consolidated storage system whereby the total storage volume is available to a number of outfalls. This may be a more efficient storage configuration than providing individual storage tanks at individual outfalls
- Minimizes the need for wet-weather outfall consolidation conduits
- Significant reduction in CSO volume, frequency, and magnitude
- Provides effective CSO storage for subsequent treatment
- Some urban amenity improvement potential is possible
- May be phased easily
- Restricts construction activities to a narrow corridor parallel to existing wastewater interceptors

Disadvantages:

- Subsurface construction along congested areas is often difficult and expensive
- May require pumping facilities
- May require substantial land area for conduit right-of-ways

Applicability:

- Areawide along interceptor routes

STORAGE: SURFACE STORAGE

ALTERNATIVE: OPEN CONCRETE TANKS / EARTHEN BASINS

Classification: Storage - Surface Storage

Description: Open concrete tanks (exposed to the surface) provide the same function as earthen basins, however they are generally more durable than earthen basins, and provide greater storage volume per unit of land area. Aeration and washdown facilities are required to prevent anaerobic conditions and to provide for cleaning after each event. Some smaller tanks can be designed to be self- cleaning using a sloping floor and an automatic sediment-flushing device.

Advantages:

- Storage tanks may be distributed throughout the combined sewer service area where most needed

Disadvantages:

- Site must be fully dedicated to pollution control
- Can result in significant odor and other community impacts

Applicability:

- Siting is generally restricted to areas of relatively low population density and industrial use

ALTERNATIVE: EARTHEN BASINS

Classification: Storage - Surface Storage

Description: Earthen basins are often the simplest and least expensive off-line CSO storage unit. Since these basins will hold combined sewage for some period of time they are generally lined to prevent contamination of groundwater. They may also be equipped with aeration and washdown facilities to maintain aerobic conditions and to provide for ease of cleaning between overflow events.

Advantages:

- Generally among the least expensive storage options

Disadvantages:

- Site must be fully dedicated to pollution control to mitigate implementation issues such as odor control and aesthetics
- Land area requirements for the basin, berms, buffers, etc, are generally large compared to other storage alternatives

Applicability:

- Earthen basins are generally applicable to open areas with low population densities and industrial areas where sufficient land is available

TREATMENT: SUSPENDED SOLIDS CONTROL

ALTERNATIVE: MICROSCREENS

Classification: Treatment - Suspended Solids Control

Description: Microscreens have very small openings, generally less than 1/250 inch (0.1 mm) and are intended to provide significant removals of suspended solids and associated BOD_5, metals, etc. Removal performance tends to improve as influent suspended solids concentrations increase due to the relatively constant effluent concentrations. In addition, screens develop a mat of trapped particles that acts as a strainer, retaining particles smaller than the screen aperture. Chemical additives can be used to improve process removal efficiencies.

Advantages:

- Good solids removal
- Relatively small land requirements
- Mature technology
- Series of screens can be clustered in order to handle varying ranges of flow
- Lends to automatic operation

Disadvantages:

- Screens susceptible to clogging and blinding, requiring intensive O&M
- No treatment of dissolved pollutants
- Requires sludge handling
- May require influent pumping
- Additional design and operation requirements when a network of screens are utilized
- Requires conventional building and power facilities

Applicability:

- End -of-pipe flow through or storage/treatment systems

ALTERNATIVE: GRAVITY SEDIMENTATION

Classification: Treatment - Suspended Solids Control

Description: The objective of sedimentation is to produce a clarified effluent by gravitational settling of the suspended particles that are heavier than water. It is one of the most common and well established unit operations for wastewater treatment. Sedimentation also provides storage capacity, and disinfection can be applied concurrently in the same tank. It is also adaptable to chemical additives such as lime, alum, ferric chloride, and polymers, which can provide higher suspended solids, BOD, nutrients and heavy metals removal.

Advantages:

- Minimal power and maintenance requirements
- Well-understood technology
- Sedimentation basins also provide some storage
- Fairly high TSS removal when properly hydraulically loaded
- Simple in design and operation
- Sedimentation facilities can be used as a contact basin for disinfection

Disadvantages:

- Large land area requirements
- New construction required
- Medium cost-effectiveness
- Installation may not be practical in congested areas
- Could be aesthetically unappealing
- Difficult O&M operations required after each storm

Applicability:

- In portions of the planning area where land is available

ALTERNATIVE: FLOCCULATION AND SEDIMENTATION

Classification: Treatment - Suspended Solids Control

Description: Flocculation, a unit process preceding sedimentation or filtration, is used to increase the removal efficiency of the sedimentation process. The major objective of flocculation (including coagulation) is to permit aggregation of colloidal particles prior to sedimentation. Coagulation is the term that describes the overall process of particle aggregation, including particle transport to cause inter-particle contact and particle destabilization to permit the attachment of particles once contact has occurred. Flocculation is the term used to describe the transport step only. Coagulation requires the addition and mixing of chemical additives.

The objective of sedimentation is to produce a clarified effluent by gravitational settling of suspended particles that are heavier than water. Sedimentation also provides storage capacity, and disinfection can be applied concurrently in the same tank. It is also adaptable to chemical additives such as lime, alum, ferric chloride, and polymers that can provide higher suspended solids, BOD, nutrients and heavy metals removal.

Advantages:

- Proven technology
- Improved performance compared to gravity sedimentation when properly hydraulically loaded
- Sedimentation basins also provide some storage

Disadvantages:

- Large land area requirements
- Medium cost-effectiveness
- Additional O&M requirements
- Additional sludge handling
- Installation may not be practical in congested area

Applicability:

- In portions of the planning area where land is available

ALTERNATIVE: DISSOLVED AIR FLOTATION

Classification: Treatment - Suspended Solids Control

Description: Dissolved Air Floatation technology uses a clarifier for the settling of suspended solids. The air flotation principal is used in this technology where small bubbles are released and attach themselves to suspended solids, effectively bringing the solids to the water surface. A skimmer is then used to remove the floating material. A bottom scraper is optional for the tank.

Advantages:

- Primary treatment of sewage, especially suspended solids removal
- Large operational ranges, concentrations, and load capacities
- Low capital costs
- High rate of solids removal and wastewater sludge thickening capabilities

Disadvantages:

- Does not have long track record in CSO technology
- Potential high maintenance costs
- Land requirements
- New construction required

Applicability:

- Can be used for TSS removal in treatment of CSOs where land is available

ALTERNATIVE: HIGH RATE FILTRATION

Classification: Treatment - Suspended Solids Control

Description: High rate filtration typically refers to a filter which has two media: anthracite coal and fine sand. Periodic backwashing of the filter bed must be provided (even if prefiltration is used) because suspended solids will clog the filter. High rate filtration has been applied to CSO treatment; however, it is more common in the treatment of industrial wastes. Flocculation is often used in conjunction with high rate filtration.

Advantages:

- Moderate land requirements
- Fairly high TSS removal (60 percent)

Disadvantages:

- High O&M requirements
- Pretreatment is required to remove coarse solids
- New construction required
- Land requirements
- Limited CSO control experience
- Medium cost-effectiveness

Applicability:

- Generally applicable to CSO treatment if facility can be sited

ALTERNATIVE: SAND AND ORGANIC FILTERS

Classification: Treatment - Suspended Solids Control

Description: Sand and organic filters, in the form or buffer strips, sand and peat filters and bioretention areas, are design to improve the water quality of small sheet flows from developed areas. The filter is often a thick mat of natural and living materials that slows the flow of storm water, encourages infiltration and provides for the removal of heavy sediment.

Advantages:

- Removal of nutrients, sediment, organic matter, pesticides and other pollutants
- Esthetically pleasing
- Little to no generated waste
- Easy maintenance

Disadvantages:

- Overall effectiveness is variable depending on quality of materials and flow rates
- Requires surface area

Applicability:

- Used ahead of flows entering conventional collection system

ALTERNATIVE: HIGH-RATE SEDIMENTATION (SWIRL CONCENTRATOR, VORTEX SEPARATOR, FLUIDSEP)

Classification: Treatment - Suspended Solids Control

Description: The main objective of swirl concentrators is to regulate both the quantity and quality of CSO at the point of overflow. Solids separation is caused by the inertia differential, which results from a circular path of travel. The flow is separated into a large volume of clear overflow and a concentrated low volume of waste that is intercepted for treatment at the dry weather wastewater treatment plant.

Pollutant removal performance of swirl concentrators, at a given hydraulic loading rate, is dependent upon the relative settleability of the waste stream being processed. Solids separation performance is much better for large heavier or gritty material than for smaller and lighter particles.

Vortex separators are similar in design and operational theory to swirl concentrators. The major difference is in the design details of the vortex chamber and the alignment of the flow concentrate outlet. The interior of the vortex chamber is smooth and free of deflectors, baffles, and gutters found in the swirl. The objective is to prevent the introduction of turbulence and to maintain the vortex action within the chamber. In addition, the flow concentrate outlet is offset in the swirl concentrator and is centered in the vortex separator. Recent experience has shown that solids separation efficiencies are, in general, greater for the vortex separator than for the swirl concentrator at equivalent hydraulic loading rates.

The Fluidsep vortex separator is a technology used to settle out solids during high flows in both separate and combined sewer systems. During dry weather, the flow enters the separator and flows freely into the discharge cone exiting through the outlet pipe for treatment. During a rain event, the high flow is transformed into a vortex motion as the solids and floatables settle out through the outlet pipe. When the volume of the chamber is exceeded, the flow (not solids) spills over the overflow baffle exiting the separator via the receiving water.

Advantages:

- High-rate equivalent primary treatment for solids removal when properly designed
- No moving parts
- Relatively small land requirements
- Good cost-effectiveness for TSS removal
- Can capture significant CSO Floatables
- Operates at high hydraulic loadings
- Minimum facility space requirements
- Treats excess wet weather flows which would be otherwise bypassed
- Low turbulence leads to favorable conditions for the settling of solids

Disadvantages:

- Estimated TSS removal is 30 to 40 percent depending on influent solids and hydraulic loading rate
- Influent pumping will likely be required for many potential sites
- Limited capacity to remove floatables
- Design criteria are still being refined
- Solids often reintroduced to interceptor need flushing
- Requires new construction
- Installation may be difficult, especially in congested areas
- Potential high maintenance costs
- Only captures solids and floatables
- Physical site limitations

Applicability:

- Areas of the system where land is available for storage and/or treatment
- The separators can be used on combined or separate sewer systems, especially near outfalls as an end-of-pipe treatment technology

ALTERNATIVE: COARSE MONOMEDIA FILTRATION

Classification: Treatment - Suspended Solids Control

Description: The main objective of *Coarse monomedia filtration* is that it utilizes a single media source whose average particle size is significantly larger than that used in fine sand filters. Compared to conventional sand filters, coarse sand filters have longer run times, they can store more captured solids, and have higher hydraulic loading rates. Periodic backwashing of the filter bed must be provided to avoid the clogging of the filter media by the suspended solids being removed. Coarse monomedia filtration often incorporates a flocculation step prior to filtration.

Advantages:

- Removal of nutrients, sediment, organic matter, pesticides and other pollutants
- Esthetically pleasing
- Little to no generated waste
- Easy maintenance

Disadvantages:

- Overall effectiveness is variable depending on quality of materials and flow rates
- Requires surface area

Applicability:

- Used ahead of flows entering conventional collection system

TREATMENT: DISINFECTION

ALTERNATIVE: CHLORINATION

Classification: Treatment - Disinfection

Description: The major objective of chlorination, and disinfection in general, is to control the discharge of pathogens and other microorganisms into receiving waters. The chlorine based disinfection agents commonly used in CSO treatment are chlorine gas, calcium or sodium hypochlorite, chloramines and chlorine dioxide. The choice of a chlorine based disinfecting agent will depend upon the unique characteristics of each agent, such as stability, chemical reactions with phenols and ammonia, disinfecting residual, and health hazards.

All chlorine based agents leave a chlorine "residual" in the waste stream, i.e. it takes time for them to dissipate once introduced. This "residual" can be quite useful in maintaining low levels of pathogens in transmission systems when required, but it may also combine with organic constituents in the receiving waters, becoming quite harmful to organisms in the waters. Depending upon receiving water quality, the effluent from the Control Facilities may require elimination of most, if not all, of its chlorine "residual". If so, de-chlorination of the effluent may be accomplished via chemical neutralization using sulfur dioxide or sodium metabisulfite, or via adsorption by activated carbon.

Adequate mixing must be provided to force the agent into contact with the maximum number of microorganisms in the limited time available before discharge. Mixing can be accomplished by mechanical flash mixers at the point of disinfectant addition, at intermittent points by specially designed contact chambers, or in conjunction with other treatment processes.

Advantages:

- Publicly acceptable practice
- Mature technology
- Many suppliers of equipment and chemicals

Disadvantages:

- Corrosive and toxic chemicals must be transported, stored and handled
- Requires a moderate level of equipment and storage facilities
- May require dechlorination
- Can have high operations and maintenance costs

Applicability:

- To all CSO storage/treatment systems where disinfection is required

ALTERNATIVE: BROMINATION

Classification: Treatment - Disinfection

Description: The major objective of bromination, and disinfection in general, is to control the discharge of pathogens and other microorganisms into receiving waters. The bromine based disinfection agents commonly used in CSO treatment are pure bromine, bromine chloride, sodium bromide and bromochlorodimethylhydantoin (BCDMH). These compounds provide a more reactive disinfectant than chlorine and its compounds meaning that significantly less chemical must be used. However, they are significantly more expensive than chlorine compounds. The choice of a bromine based disinfecting agent will depend upon the unique characteristics of each agent.

All bromine compounds leave a “residual” in the waste stream, which, like chlorine compounds, can be useful in maintaining low pathogen levels in transmission systems. Bromine compounds also combine with organic constituents in the receiving waters. There are conflicting reports as to the toxicity of these bromo-organic compounds, though the effluent from the Control Facilities may still require elimination of most, if not all, of its bromine “residual”. If so, de-bromination of the effluent may be accomplished via chemical neutralization using sulfur dioxide or sodium metabisulfite, or via adsorption by activated carbon.

Adequate mixing must be provided to force the agent into contact with the maximum number of microorganisms in the limited time available before discharge. Mixing can be accomplished by mechanical flash mixers at the point of disinfectant addition, at intermittent points by specially designed contact chambers, or in conjunction with other treatment processes.

Advantages:

- More reactive disinfectant than chlorine
- More soluble than chlorine based agents
- Residuals are less persistent than those of chlorine agents

Disadvantages:

- Limited availability of bromine compounds

- Limited full-scale application experience for CSOs
- Corrosive and toxic chemicals must be transported, stored and handled
- Requires a moderate level of equipment and storage facilities
- May require dechlorination
- Can have high operations and maintenance costs

Applicability:

- To all CSO storage/treatment systems where disinfection is required

ALTERNATIVE: OZONATION

Classification: Treatment - Disinfection

Description: Ozone is a highly effective chemical disinfectant whose use in the wastewater field is continually increasing. Normally, small ozone gas bubbles are dispersed up through the waste stream to ensure maximum contact with pathogens. Unlike chlorine and bromine, once ozone is introduced to the waste stream, it dissipates rapidly and leaves no residual. Ozone is a very unstable compound, and it is toxic to humans. For these reasons, ozone gas must be generated on-site, used immediately, and the unused ozone in the off-gas must be collected and disposed of safely. Ozonation requires a significant electrical power source for the on-site production of ozone gas.

Advantages:

- Not harmful to habitat.
- Superior and most natural agent for sanitation disinfection

Disadvantages:

- Typically not economical
- Operations concerns at unmanned locations
- Safety concerns regarding chemical handling
- Needs power station
- Pollution created through electricity generation

Applicability:

- At wastewater treatment plant or treatment locations

ALTERNATIVE: MICROFILTRATION

Classification: Treatment - Disinfection

Description: An …

Advantages:

- Eliminates …

Disadvantages:

- Has

Applicability:

- Most effective …

ALTERNATIVE: ULTRAVIOLET DISINFECTION (UV)

Classification: Treatment - Disinfection

Description: UV radiation is highly effective at killing pathogens. Light produced by UV lamps penetrates the cell structures of pathogens and alters the DNA make-up of those cells, prohibiting the organisms from reproducing. UV radiation is commonly applied to the waste stream in a channel where the effluent flow rate can be controlled to ensure irradiation at high intensities and maximum contact times. UV radiation is similar to ozone in that it is toxic to humans, it leaves no residual in the effluent, and it must be generated on-site for immediate use.

Advantages:

- Eliminates the need for transport, handling, and storage of flows
- Computer monitored UV lamps optimize disinfection according to varying flows
- 60 second contact time (chlorine = 30-60 minutes)
- Physical process is safe and effective
- Easily installed
- Generally used for small flows - less than 10 mgd

Disadvantages:

- Has limited success in high solids environment
- Careful maintenance required
- Expensive, especially high cost of energy output
- No removal of suspended solids

Applicability:

- Most effective at a treatment plant

TREATMENT: FLOATABLES AND COARSE SOLIDS CONTROL

ALTERNATIVE: STATIC SCREENS

Classification: Treatment - Floatables Control

Description: Static screens are typically placed on the overflow weir in regulator structures. The screens usually consist of "trash racks" that must be manually cleaned or replaced when full, with the screenings either returned to the sanitary sewer system for removal at the treatment plant or are placed in a dumpster for proper disposal elsewhere. Static screens have openings that range from 3/8 inch to 1.5 inches.

Advantages:

- Unwanted debris and floatables are kept out of receiving waters

Disadvantages:

- A building may be required to house and conceal equipment and the solids collected
- High maintenance involved to clean screens

Applicability:

- For end-of-pipe treatment at or near regulator structures
- Site-specific

ALTERNATIVE: MECHANICAL SCREENS

Classification: Treatment - Floatables Control

Description: Mechanical screens are used to separate floatable material from CSO's, providing pre-treatment to combined sewage entering storage or treatment facilities. The screens are mechanically cleaned using rakes that pull trash off the bar screens to be either returned to the sanitary sewer system for removal at the treatment plant or are placed in a dumpster. Mechanical screens have openings that range from 3/8 inch to 1.5 inches.

Advantages:

- Unwanted debris or floatables kept out of receiving waters

Disadvantages:

- Construction of a building to house and conceal equipment and the solids collected
- High maintenance involved to clean screens

Applicability:

- For end-of-pipe treatment at or near regulator structures
- Site-specific

ALTERNATIVE: IN-LINE NETTING

Classification: Treatment - Floatables Control

Description: In-line netting systems are static-flow control devices used for either end-of-pipe collection or area collection in a receiving water body. The energy of the effluent stream pushes floatable materials into the netting. Netting systems typically are modular, with disposable bags, lifting baskets, and a support frame being housed in a pre-cast concrete chamber. Often, a secondary bypass screen is located above the bags to ensure 100% screening of the CSO under all conditions and to prevent surcharging. Most nets are made buoyant by floats or pontoons.

Advantages:

- Can significantly reduce aesthetic impacts in sensitive receiving waters
- Maximizes use of existing facilities
- Has minimal hydraulic problems
- When installed in lakes, tributaries or quiescent estuarine waters, nets can be inexpensive
- Moderate implementation period

Disadvantages:

- Installation may be within public view, causing undesirable aesthetics
- Maintenance access can be difficult
- Replacement costs are high for torn nets or booms; potential high maintenance costs
- Nets are installed at the end of pipe or in the receiving stream
- Only captures floatables and aesthetic nuisances
- No significant water quality improvement
- Frequent O&M requirements, sometimes after each overflow event
- Potential for odors and an aesthetic nuisance if near high-use water front areas
- Not viable in rough, open water
- Technology has not yet been widely applied

Applicability:

- End-of-pipe applications, often flat sewers with flooding potential

ALTERNATIVE: CONTAINMENT BOOMS

Classification: Treatment - Floatables Control

Description: Containment booms are floating devices used in the receiving water near an overflow pipe to contain floating materials from CSOs. Solids trapped by these booms must then be collected and disposed of properly. The booms are made of neoprene rubber with a Hypalon external skin, and include an anchoring system to control / restrict the movement of the device.

Advantages:

- Operated worldwide, especially with industry response organizations
- Can deployed in under 15 minutes with high capacity air blower
- Less expensive than other Floatables technologies

Disadvantages:

- Not aesthetically appealing
- To be effective, booms must be serviced by a skimmer vessel
- High level of maintenance
- Becomes an eyesore if not maintained

Applicability:

- At outfall locations, especially near recreational areas and beaches

ALTERNATIVE: REGULATOR UNDERFLOW BAFFLES

Classification: Treatment - Floatables Control

Description: Regulator underflow baffles consist of a network of transverse baffles mounted in front of, and perpendicular to, an overflow discharge outlet. During wet weather, flow passes under and around the baffles while buoyant materials (the “floatables”) are retained behind the baffles. The floatables are then returned to the sewer system for treatment at the wastewater treatment plant.

Advantages:

- Estimated cost of installing underflow baffles significantly less than similar technologies
- Baffle installation is feasible at existing regulator structures

Disadvantages:

- Percent floatables capture not as high as other technologies
- Possible plugging of dry weather flow connection depending on quantity of floatables
- At high flow velocities, floatables may be “sucked” down / around the baffles
- To achieve reasonable efficiencies, existing chambers will need extensive modifications

Applicability:

- Typically installed at regulator structure locations that infrequently overflow.

ALTERNATIVE: CATCH BASIN INSERTS AND MODIFICATIONS

Classification: Treatment - Floatables Control

Description: Catch basin inserts, such as a drain diaper, consist of polypropylene fabric held in place by the basin's existing metal grate. The insert collects litter, grease, oil, and other sediment from the storm water before it reaches the sewer system.

Advantages:

- Reduces sump maintenance requirements
- Low cost solution for storm water pollution
- Low maintenance (pumping, cleanup)
- Monitoring capabilities at each catch basin

Disadvantages:

- Labor required to periodically change the inserts
- Can clog, reducing the quantity of storm water that the system can collect

Applicability:

- All catch basin locations

ALTERNATIVE: BRUSH SCREEN

Classification: Treatment - Floatables Control

Description: A brush screen is a fairly new technology for screening CSO at regulator structures. Brush screens are normally made up of a number of horizontal cylinders containing fine bristles that provide solids removal. They are mounted on a center shaft atop an overflow weir, are powered by the influent flow hydraulics, and rotate against the flow. Cleaning of the bristles is achieved by the use of a fixed comb; once "combed" from the bristles, the solids are collected in a trough for disposal back into the system once flows decline. Removal of solids down to 4mm in diameter can be achieved.

Advantages:

- Requires no hydraulic pack or electricity, self powered, therefore unaffected by power failure
- Modular design allows for custom fitting and for retrofitting of existing systems
- Self cleaning screening elements and stainless steel construction

Disadvantages:

- Requires significant maintenance due to tendency to collect "stringy" materials
- Limited installation experience in North America

Applicability:

- Applicable in regulator structures on top of overflow weirs

ALTERNATIVE: CONTINUOUS DEFLECTIVE SEPARATION

Classification: Treatment - Floatables Control

Description: Continuous deflective separation technology is a variation of vortex separator technology in which a physical barrier, such as a fine screen (4mm), is combined with the properties of swirling water to provide a continuously cleaning system for the capture of large debris. Though all flows pass through the screen, the continuous swirling action in the unit's sump causes heavier solids to fall to the bottom, keeping them from accumulating on the screen and eliminating the need for a cleaning mechanism. Solids accumulated in the bottom of the sump must be removed at the conclusion of a storm event. This technology is capable of removing small solids and floatables.

Advantages:

- Small footprint in comparison of competing technologies
- Effectively capture floatables, heavy and large sediment

Disadvantages:

- Does not capture sediment smaller than the screen's hole diameter
- Requires periodic cleaning to removed captured materials
- May require removal of captured materials during storm events, if quantities are large enough
- Does not affect pathogen levels

Applicability:

- At outfall locations, especially near recreational areas and beaches

TREATMENT: HIGH-RATE END OF PIPE

ALTERNATIVE: BALLASTED FLOCCULATION

Classification: Treatment - High-Rate End of Pipe

Description: Ballasted flocculation is a high-rate clarification using microsand-enhanced flocculation along with a settling process. The coagulant used is a multivalent salt (ferric chloride). It is mixed with a polymeric flocculent within the microsand. This process has been used in Europe.

Advantages:

- Able to handle high hydraulic loading with short retention time
- Low land requirements
- 85-95% of TSS, 60-80% TBOD, and high removal rates

Disadvantages:

- New construction required
- High operations and maintenance required
- Only test pilot applications to date in the U.S.
- Sludge handling required

Applicability:

- At regulator locations/treatment plants
- Typical installation is on a CSO outfall as part of a treatment system

ALTERNATIVE: CLARIFICATION

Classification: Treatment - High-Rate End of Pipe

Description: The DensaDeg 4D Storm Water is a high-rate treatment process that provides four process functions: grit removal, grease and oil removal, clarification, and sludge thickening. The system provides high-rate coagulation, flocculation, and sludge thickening to provide primary and secondary equivalent treatment to wastewater flows. System includes the options of a Climber Screen for debris removal and UV disinfection capabilities.

Advantages:

- Provides high removal rates equivalent to secondary treatment
- Accommodates a wide range of flow rates with fast build-up to operational capacity
- Compact, smaller footprint than traditional WWTP process through integration of all functions in a single unit

Disadvantages:

- No track record of U.S. applications
- Sludge handling required
- High operations and maintenance required

Applicability:

- Storm and combined sewers are the most likely choice for placement of these structures, particularly where waste solids pose a problem

ALTERNATIVE: CO-MAG

Classification: Treatment - High-Rate End of Pipe

Description: The CoMag system is a magneto-chemical high-rate clarification process that utilizes magnetite (small iron granuals) to enhance flocculation, along with a settling process. The coagulant used is normally a multivalent salt (ferric chloride or alum). The system is capable of handling a large range of influent flows and suspended solids concentrations, and can be rapidly be started or shut down depending upon flow fluctuations. Suspended solids concentrations in the effluent can be further reduced by the use of an electromagnet (see High-Gradient Magnetic Separation, below) to remove the remaining magnetite-seeded flocs. The process effectively removes phosphorus, as well as total suspended solids (TSS), biochemical oxygen demand (BOD), color, and turbidity. It has also shown that it can remove pathogens without chemical disinfection.

Advantages:

- Very small process footprint required
- Rapid start-up and shut-down capabilities
- Effective over wide fluctuations in flow

Disadvantages:

- Not widely used for CSO treatment at this time
- May have high O&M requirements due to complexity
- Sludge handling is required
- Periodic chemical and magnetite replenishment required
- Does not address removal of floatables
- Applicability:
- At regulator locations/treatment plants
- Typical installation is on a CSO outfall as part of a treatment system

TREATMENT: CSO TREATMENT FACILITIES (CSOTF)

ALTERNATIVE: CSO STORAGE AND SEDIMENTATION

Classification: Treatment – CSO Treatment Facilities (CSOTF)

Description: With the expansion and upgrade of the ALCOSAN WWTP, the potential for more CSO capture is made possible.

CSO Treatment Facilities are near-surface storage/primary treatment units used for wet-weather flows at CSO outfalls or at a treatment plant site.

Advantages:

- Water quality improvement
- CSO reduced and treated to equivalent primary level
- Peak overflow rate reduced
- Coarse screening used to keep large objects out
- Can accommodate disinfection

Disadvantages:

- New construction involved
- Land requirements
- Expensive

Applicability:

- At CSO outfalls or adjacent to a treatment plant.

ALTERNATIVE: CSO DETENTION AND TREATMENT

Classification: Treatment – CSO Treatment Facilities (CSOTF)

Description: CSO Detention and Treatment facilities are near-surface primary treatment units used for wet-weather flows at CSO outfalls or at a treatment plant site.

Advantages:

- Water quality improvement
- CSO reduced and treated to equivalent primary level
- Peak overflow rate reduced
- Coarse screening used to keep large objects out
- Can accommodate disinfection

Disadvantages:

- New construction involved
- Land requirements
- Expensive

Applicability:

- At CSO outfalls or adjacent to a treatment plant.

TREATMENT: "OTHER" TECHNOLOGIES

ALTERNATIVE: SIDESTREAM ELEVATED POOL AERATION

Classification: Treatment – "Other" Technologies

Description: Sidestream elevated pool aeration (SEPA) is a process used to re-oxygenate receiving streams in order to improve water quality. The re-aeration is achieved by pumping a portion of the receiving stream into an elevated pool, returning the diverted water through a series of cascades back to the stream. This approach won the 1994 Outstanding Civil Engineering Achievement Award for the Metropolitan Water Reclamation District of Greater Chicago. Weir loadings of 2.5 cfs/foot at a 3 to 5 foot drop have achieved 95-100% dissolved oxygen saturation, according to published reports.

Advantages:

- No chemicals required
- Aesthetically pleasing and can be combined with a park system.
- Controls numerous outfalls at the same time.
- No odor problem due to constantly moving water

Disadvantages:

- Regulatory approval may be difficult due to limited track record
- May require pumping
- SEPA does not remove suspended solids, BOD, or floatables

Applicability:

- At CSO outfalls or combinations of outfalls.

ALTERNATIVE: CARBON ABSORPTION

Classification: Treatment – "Other" Technologies

Description: Carbon Absorption is a filtration process using activated charcoal to remove dissolved organic particles. Absorption takes place due to the intermolecular attraction between the carbon surface and the substance that is being absorbed. As the fluid passes over and through the carbon, the attractive forces between the compounds that are most attracted to the carbon are adsorbed onto the surface. The compounds most attracted are typically organic compounds, volatile organic compounds (VOCs), and halocarbons such as trihalomethane (THM) compounds.

Advantages:

- Removes color, odor, and taste from water

Disadvantages:

- Expensive to implement
- Intensive operating procedures
- Used mostly in water treatment to help remove taste, color, and odor from the water
- Not used for microorganism control
- Particulate matter may clog the adsorbent bed
- Process typically used in the continuous process of water treatment. Having the process dormant during dry weather periods then suddenly loading the process during wet weather may impact the operation of the process.

Applicability:

- At existing wastewater treatment locations

ALTERNATIVE: HIGH-GRADIENT MAGNETIC SEPARATION (HGMS)

Classification: Treatment – "Other" Technologies

Description: HGMS is a rapid filtration technology that uses fibrous, ferromagnetic coagulation materials to form magnetic flocs with the settleable solids within the waste stream. A strong external magnetic field is then applied to the waste stream, essentially pulling the flocs (and settleable solids) out of the waste stream.

Advantages:

- Removes color and odor

Disadvantages:

- Expensive
- Intensive operating procedures
- Used mostly in water treatment
- Pre-treatment required.
- Process typically used in the continuous process of water treatment. Having the process dormant during dry weather periods then suddenly loading the process during wet weather may impact the operation of the process.

Applicability:

- At existing wastewater treatment locations

ALTERNATIVE: CONSTRUCTED WETLANDS

Classification: Treatment – "Other" Technologies

Description: Wetland areas are an ideal location for biochemical reactions to occur in wastewater treatment. This process involves the soil, air, and sunlight being used to remove contaminants from the water. The land area required for 100,000 gallons is 1-2 acres. The size of the wetland is critical to providing adequate waste stream detention time so that all required natural processes may occur. Thus, site constraints become a key consideration for sewersheds located in urban / residential / commercial areas and those expected to produce large overflow volumes.

Advantages:

- No chemicals used
- Works in sub-zero weather
- No odor problem due to constantly moving water
- Aesthetically pleasing

Disadvantages:

- Requires new construction treatment units
- Requires large pieces of land
- Possible exposure to bacteria if placed in urban area
- Wetlands treatment does not remove BOD, ammonia, or floatables
- Strict sizing requirements required to ensure wetland is not overloaded during first flush.

Applicability:

- Site specific

ALTERNATIVE: INCREASE TREATMENT CAPACITY

Classification: Treatment – "Other" Technologies

Description: If ALCOSAN's WWTP is expanded and upgraded to 875 mgd as planned, more CSO capture would be possible.

Advantages:

- Previously untreated overflows will be processed prior to entering receiving waters
- Significant reduction in CSO volume

Disadvantages:

- New construction required
- Expensive
- ALCOSAN, as an entity, is independent of PWSA

Applicability:

- Treatment plant locations

ALTERNATIVE: ENCLOSE BEACH AREA

Classification: Treatment – “Other” Technologies

Description: Enclosing the beach area is a technology geared towards the creation of a curtain wall around a recreational area. The partitioned area becomes a pool where treatment techniques can be applied or where the volume can be pumped back to the collection system for treatment.

Advantages:

- Possible chlorine treatment in partitioned areas
- Utilizes uninhabited surface area
- Safer recreational areas

Disadvantages:

- Harmful effects to habitat
- High maintenance
- Public perception
- Cost of pump back

Applicability:

- Applicable away from recreational areas (beaches) on the shores of the Monongahela, Allegheny and Ohio rivers.
- Dunker’s Flow Balancing System is an example.

The Pittsburgh Water and Sewer Authority
CSO Long-Term Control Plan
CSO Control Technologies and Initial Analysis Approach Summary

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INTRODUCTION

A technology review and initial analysis was performed as part of the Pittsburgh Water and Sewer Authority (PWSA) CSO Long-Term Control Plan to identify and categorize feasible wet-weather control technologies for use in developing CSO control alternatives. Both established and innovative CSO technologies were analyzed as possible solutions, and were targeted at closing CSOs, expanding sewershed conveyance capabilities, combining CSOs, and constructing regional CSO treatment and/or storage facilities. Each technology was presented in a data sheet that provided a system description, its advantages and disadvantages, and its application to the PWSA collection system.

An extensive inventory of feasible CSO control technologies was compiled for the planning process. This summary documents those technologies identified and categorized for screening. They were grouped into four functional categories of wet weather CSO control:

- Source Control
- Collection System Optimization
- Storage
- Treatment

This summary contains a brief description of the general classes of the technologies. Following is the "Initial Analysis" section that presents the proposed approach to screen the technologies. Data sheets for each identified technology are included in Appendix A.

CSO CONTROL TECHNOLOGIES

Based on the CSO activities in other communities, technical literature, and information provided by manufacturers, vendors and other industry sources, over 70 individual CSO control technologies were reviewed for consideration in the PWSA. These are summarized in Table 1. Appendix A includes a data sheet for each that provides a technology description, summarized the advantages and disadvantages, and notes the applicability of the technology for service in the PWSA service area. CSO control technologies can be grouped into four major categories:

- Source Control
- Collection System Control
- Storage
- Treatment

Table 1 - PWSA LTCP Technologies

Source Control	
Best Management Practices: • Catch Basin Cleaning • Street Cleaning • Litter Control • Deicer Control • Fertilizer and Pesticide Control • Hazardous Material Control • Industrial Runoff Control • Water Conservation • Public Education • Sewer Use Bylaws • Spills Emergency Program **Infiltration/Inflow Control:** • Sewer and Manhole Rehabilitation • Roof Leader and Footing Drain Disconnection • Cross Connection Removal	**Storm Water Management Practices:** • Upstream Storm Water Storage • Porous Pavement • Infiltration Trenches and Basins • Erosion and Sedimentation Control • Overland Flow Slippage and Catch Basin Restriction • Storm Sewer Exfiltration and Infiltration Systems • Water Quality Inlets (Stormtreat System, Stormceptor System, Downstream Defender, CSF Storm Water Treatment Systems) • Private Property Storage (Rain Harvesting) • Storm Water Permitting • Urban Forest Structure
Collection System Control	
Sewer System Optimization: • Remove Bottlenecks (Pipe Capacity and Connection Hydraulic Improvements) • Sewer Cleaning and Maintenance • Polymer Injection (Lining and Coating) **Regulator Optimization:** • Static Regulator Device Improvements • Swirl/Helical, Plunge, and Vortex Energy Dissipaters	**Regulator Optimization cont:** • Bending Weir (GNA Hydrobend) • Drop Structure Optimization **Inter-Basin Flow Balancing/Relief:** • Inter-Basin Flow Transfer • Relief Sewers **Sewer Separation:** Complete or Partial Separation

Storage

In-line Storage:
- Inflatable Dams
- Manual and Automatic Gates
- Existing Unused Conduits
- Static Flow Control Strategies
- Variable Flow Control Strategies
- Real-Time Control Strategies

Subsurface Storage:
- Tunnel Storage
- Closed Concrete Tanks
- Storage and Conveyance Conduits

Surface Storage:
- Open Concrete Tanks
- Earthen Basins

Treatment

Suspended Solids Control:
- Microscreens
- Gravity Sedimentation
- Flocculation and Sedimentation
- Dissolved Air Flotation
- High-Rate Filtration
- Sand and Organic Filters (Buffer Strips, Sand and Peat Filters, Bioretention Areas)
- High-Rate Sedimentation
- Coarse Sand Filters

Floatable and Coarse Solids Control:
- Static Screens
- Mechanical Screens
- In-line Netting
- Containment Booms
- Regulator Underflow Baffles
- Catch Basin Inserts and Modifications
- Brush Screens
- Continuous Deflective Separation (CDS)

Disinfection:
- Chlorination
- Bromination
- Ozonation
- Microfiltration
- Ultraviolet Disinfection (UV)

High-Rate End of Pipe Treatment:
- Ballasted Flocculation
- Clarification
- CoMag

CSO Treatment Facilities (CSOTF)
- Storage & Sedimentation
- Detention & Treatment

"Other" Technologies
- Sidestream Elevated Pool Aeration
- Carbon Absorption
- High-Gradient Magnetic Separation (HGMS)
- Constructed Wetlands
- Existing Treatment Plant Expansion
- Enclose Beach Area

A brief description of each of these technology categories is provided below.

SOURCE CONTROL

Source control technologies or practices are designed to minimize flows and / or pollutants entering the collection system. These technologies typically do not require large capital expenditures for implementation. They must often be applied at smaller sites and may require labor intensive efforts or widespread public and community participation for effectiveness. Source control measures include the following sub-categories:

- Best Management Practices (BMPs)
- Infiltration and Inflow (I/I) Control
- Stormwater Management Practices

Best Management Practices (BMP). BMPs include a series of practices designed to control pollutant sources, and generally include programs that manage pollutants entering receiving waters via existing conveyance and surface run-off sources. These programs may include the following:

- Catch Basin Cleaning
- Street Sweeping
- Litter Control
- Deicer Control
- Fertilizer and Pesticide Control
- Hazardous Material Control
- Industrial Runoff Control
- Water Conservation
- Public Education
- Sewer Use Bylaws
- Spills Emergency Program

Catch basin cleaning is a method often proposed in CSO control programs to reduce the heavy "first flush" effect that these deposited solids have on storm water flows, and to help reduce sediment buildup in the sewers. Cleaning can be performed manually or by eductor, bucket, or vacuum.

Street sweeping is normally used to enhance roadway appearance. However, the periodic removal of surface accumulations of litter, debris, dust, and dirt also reduces transport of such material into the sewer system. Common methods of street sweeping include manual sweeping, mechanical broom sweepers, and vacuum sweepers. Sweeping effectiveness is a function of several factors: sweeper efficiency, cleaning frequency, number of passes, equipment speed, pavement conditions, equipment type, portion of streets swept, litter control programs, and parking restrictions.

Litter control regulations often include ordinary litter as well as litter from pet feces. The enforcement of anti-litter bylaws can help prevent litter such as paper, cans, cigarettes, etc. from reaching the street and, if not removed by street cleaning equipment, subsequently reaching a storm water discharge. Although litter ordinances do not appear to be effective water quality management tools, they can reduce the amount of trash collected at screening facilities, the quantity of floatables observed at outfalls, and sources of bacteria contributed by domestic pets.

Deicer control minimizes the ability of street runoff from melting snow and ice to mix with deicers such as chloride salts. Once mixed, the deicer reaches receiving waters through one of three pathways: 1) transport to, and discharge from, local sewage treatment plants; 2) through storm sewer discharges; and 3) by dumping snow removed from streets into the receiving water. There are two options to mitigate the impact of deicers on receiving water. The first is to find an alternative substance with which to replace chloride salts, such as sand or cinders. The second is to modify salt storage and application procedures in order to minimize impacts.

Fertilizer and pesticide control involves removing these pollutants at their source, preventing them from entering receiving waters. The majority of fertilizers and pesticides, if properly applied, are reasonably innocuous to the environment, but should be applied sparingly and as a last resort. A recommended option for a municipality is to limit the use of fertilizers, pesticides, herbicides and other chemicals to uses consistent with their intended purpose, and provide appropriate considerations to their storage and distribution. Homeowners should also be encouraged to follow similar guidelines on private property.

Hazardous material control programs seek to control the use and disposal of fertilizers, herbicides, pesticides, used oil, and other materials that can have a detrimental effect on the environment. One common practice is to provide a community wide drop-off date for hazardous materials such as solvents, oils, and paints. Used oil recycling centers have also gained popularity.

Industrial runoff controls are designed to control industrial and commercial runoff that contributes significant amounts of pollutants such as grease, oil, and toxins to combined sewer systems. Areas of concerns are factories, gas stations, parking lots, and rail yards. Pretreatment of oil and grease is an effective control measure.

Water conservation methods aim to reduce water usage, water supply requirements and wastewater treatment needs. There are a number of conservation methods, including distribution system leak detection and repair, mandatory alterations to buildings, industrial water re-use, installation of water efficient devices in homes, water use restructuring, and public education.

Public education programs focus on the proper uses of sewers, the impacts of discharges to sewers, and the various issues and constraints associated with available discharge alternatives. They can greatly assist a government endeavoring to implement pollution control, since not only does education promote good practices, it also keeps the municipality's efforts to control pollution in the public's mind on a continuous basis.

Sewer use bylaws enacted by a community allow for the prohibition of unwanted discharges into collection systems. The laws also provide the community with an avenue through which illicit discharges can be stopped and costs for clean up and mitigation can be recovered

Spills emergency programs are set protocols for the reaction to, and containment of, spills. They are developed by communities across department lines and include input from Engineering, O&M, Police, Fire and community managers.

Infiltration/Inflow (I/I) Control. Methods to control Infiltration and Inflow into sewer systems include the following:

- Sewer and Manhole Rehabilitation
- Roof Leader and Footing Drain Disconnection
- Cross Connection Removal

Sewer and manhole rehabilitation activities are performed to reduce I/I caused by these extraneous flows. Manhole renovations typically address leakage sources such as holes in the manhole cover, the improper positioning of the cover, or gaps between the manhole structure and cover frame. Pipeline rehabilitation also addresses leakage sources such as pipe joints, cracks, and failed side connections. Additionally, pipeline rehabilitation could be used to improve performance of the sewer by reducing its roughness (thereby increasing its flow characteristics) or by providing uniform diameter transitions.

Roof leader and footer drain disconnections limit runoff from impervious surfaces that contributes significantly to the flow entering the collection system. Other measures to reduce runoff include removing or modifying catch basins to reduce the rate that flow could enter the collection system. This may be effective in reducing the peak flows. Other measures include rooftop storage, intentional "ponding" in streets and parking lot surfaces, and localized infiltration systems. Other inflows, such as direct or indirect connections of separate sanitary sewers, could also be transported through the combined sewer system.

Cross connection removal eliminates the mixing of sanitary and storm flows via these direct and indirect connections. Direct connections occur when storm sewers inadvertently connect to sanitary sewers, or when common trench configurations for sanitary and storm sewers result in the sharing of access manholes. Indirect connections typically result from cracks within the separate sanitary sewers. Extraneous water may flow from the storm sewer into the sanitary sewer, or vice versa, along a common trench or another pathway.

Storm Water Management Practices. Storm water management practices involve technologies that control storm water flow or pollutant loads prior to their entrance into the combined sewer system. These practices may include the following storm runoff attenuation or upstream storm water storage to hold or divert storm flow from the collection system, thus reducing total CSO volumes and frequencies:

- Upstream Stormwater Storage (i.e. Detention Basins)
- Porous Pavement
- Infiltration Trenches and Basins
- Erosion and Sedimentation Control
- Overland Flow and Catch Basin Restrictors
- Private Property Storage
- Stormwater Permitting
- Urban Forest Structure
- Storm Sewer Exfiltration and Infiltration Systems
- Water Quality Inlet Facilities (Stormtreat, Stormceptor, End-of-pipe Defender, etc.)

Upstream stormwater storage commonly includes stormwater retention and detention ponds used to control peak rates and volumes of surface runoff in areas served by separate storm sewers. Such ponds can be used within a combined sewer service area to control the rate of surface runoff entering the combined sewer collection system. Reduced flow rates within the combined sewers will result in interception and treatment of a larger portion of the flow, thus reducing the volume of CSO.

Porous pavement consists of various surface treatments ranging from concrete pavers to porous asphalt. Concrete pavers rely on the paver joints to provide the pervious area for infiltration. Porous asphalt technology involves installation of a pervious, open-graded asphalt wearing course over a base course with large void spaces. The base course functions as a detention reservoir. Rain then passes through the wearing course, collects in the void space of the base course, and ultimately drains away by natural infiltration.

Infiltration trenches and basins are constructed facilities that slow the flow of stormwater enough to allow it to infiltrate into the ground. Trenches are long, narrow facilities, while basins can take virtually any shape. For infiltration trenches and basins to be effective, the area ground water table must be sufficiently low and the soil infiltration rates must be sufficiently high. This method encourages recharge of the groundwater table, removes a significant number of pollutants from the storm water, and can also assist in reducing peak flows in the system by acting as a source control.

Erosion and sedimentation control measures reduce the potential for eroded material to enter the sewer system and ultimately be discharged to receiving waters. Erosion and sedimentation control measures can be required at construction sites and storage areas for salt, sand, and other erosion prone materials. At construction sites, control measures should include the maintenance of natural vegetation to the extent possible; the use of hay bales to filter runoff; the use of crushed rock or rip rap in drainage channels to help attenuate runoff; the covering of stockpiled materials; and the use of storm water sedimentation basins to attenuate runoff and provide solids deposition. At storage areas, stockpiled materials should be covered or located within shelters.

Overland flow slippage and catch basin restriction is a method of preventing storm water from entering the sewer system at a location by channeling the flow to an alternate destination. This is typically performed by altering the inlets to surface drains to block inflow and allow it to “slip” by. Routing storm water runoff overland to a nearby drainage system or receiving water that is able to accommodate the flow is known as overland flow slippage. Retaining stormwater on the surface of streets during critical peak flows to allow more sewer capacity for wastewater flows is known as catch basin restriction.

Private property storage collects rainfall from rooftops for use as a non-potable water source. Applications include yard landscaping and garden watering, car washing, and summertime childrens’ activities. Specific options include rain barrel collectors and “green roofs”.

Storm water permitting allows for the control of discharges into the stormwater system from construction sites or other regulated sites.

Urban forest structure reclaims the dynamic of the stream ecosystem through the planting and encouragement of the growth of trees, ground cover and small brush. The stream ecosystem slows the flow of storm water into the receiving water and allows for the absorption of storm water by plant life.

Storm sewer exfiltration and infiltration systems utilize constructed systems that resemble French Drains to control runoff. The exfiltration process allows runoff to enter local catch basins, where it then enters the storm sewer. At the adjacent downstream manhole, the flow drops into perforated pipes that are plugged at their downstream end. The water passes through the pipe perforations into a stone filled trench, and from there it seeps into the surrounding native soils. When the quantity of runoff exceeds the designed capacity of the perforated pipes, the water will flood the exfiltration system. At this point, the stormwater will begin to be conveyed via the conventional storm sewer pipe.

The infiltration process also allows runoff to be filtered through a perforated pipe into a stone filled trench. However, instead of exfiltrating into the surrounding native soils, the stormwater is collected again at the bottom of the trench by a smaller perforated drainpipe. It is then discharged back into the storm sewer system at the adjacent downstream manhole. Again, once the capacity of the first perforated pipe is exceeded, water will back up in the catch basin until it overflows into the conventional sewer.

Water Quality Inlet Facilities have become increasingly popular for use in controlling oil, grit, and hydrocarbon loadings that are generally associated with parking lot runoff. Inlets are only designed to store a fraction of the design storm, however they separate some of the coarse sediment, oil/grease, and debris in urban runoff. Fine grained particulate pollutants, such as silts, clay, and associated trace metals and nutrients are less likely to be removed. There are various types of specialized products that are included in this classification.

The STORMTREAT™ System (STS), developed in 1994, is a storm water treatment technology consisting of a series of sedimentation chambers and constructed wetlands that are contained within a modular, 9.5 foot diameter recycled-polyethylene tank. Influent is piped into the sedimentation chambers where pollutant removal processes such as sedimentation and filtration occur. Storm water is conveyed from the sedimentation chambers to a constructed wetland where it is retained for five to ten days prior to discharge. Unlike most constructed wetlands for storm water treatment, the storm water is conveyed into the subsurface of the wetland and through the root zone. It is within the root zone that greater pollutant attenuation occurs through processes such as filtration, adsorption, and biochemical reactions.

STORMCEPTOR is a storm water treatment device that removes oil and suspended solids. The STORMCEPTOR structure traps oil and any liquid with a specific gravity less than water, along with suspended solids.

END-OF-PIPE DEFENDER consists of a concrete cylindrical vessel with a sloping base and internal components. Raw liquid is introduced tangentially into the side of the cylinder and spirals down the perimeter allowing heavier particle to settle out via gravity and the drag forces from the wall and base. By the time the water level reaches the top of the vessel, it is virtually free of solids, which are stored in the base of the vessel.

Storm water Management's CSF is designed to treat stormwater pollution utilizing a variety of filter media, including organic processed deciduous leaf media. It has been demonstrated to remove oils, greases, soluble metals, sediment, total phosphorous and other pollutants form in storm water runoff.

COLLECTION SYSTEM OPTIMIZATION

Collection system optimization technologies are introduced into existing sewer systems to enhance their conveyance and / or storage capabilities. Technologies in this category typically increase the system capacity by allowing full utilization of the collection system, or by retaining flow in segments of the system where extra storage capacity is available. They include:

- Sewer System Optimization
- CSO Regulator Optimization
- Inter-basin Flow Balancing / Relief
- Sewer Separation

These technologies may help reduce the overall cost of CSO control programs because they maximize the conveyance and storage of flows in existing sewerage facilities so that the sizing of additional CSO control structures can possibly be reduced.

Sewer System Optimization. Optimization technologies improve flow characteristics within existing sewer systems, and include the following:

- Removal of Bottlenecks
- Sewer Cleaning and Maintenance
- Polymer Injection (i.e. pipe lining and coating)

Removal of bottlenecks refers to control methods that address the portions of the collection system that act to constrict flow due to "bottlenecks" caused by inadequate pipe diameters or blockages. These control methods remove physical barriers in the pipes, or replace small sections of sewers that act as flow restrictions.

Sewer cleaning and maintenance activities that serve to improve flow capacity are also considered sewer system optimization methods.

Polymer injection systems are designed to coat pipes, creating a "lining" having a reduced roughness coefficient so that the pipe may convey larger flows.

Regulator Optimization. Often, regulators can be modified or even eliminated to better manage CSO volumes and frequencies. Regulated flows entering the interceptor system could be increased in wet weather conditions to reduce CSO volume and / or frequency if available interceptor capacity exists to receive and convey these flows. Regulator optimization methods include the following:

- Static Regulator Device Improvements (gates or weirs)
- Swirl / Helical, Plunge and Vortex Energy Dissipaters
- Bending Weirs
- Drop Structure Optimization

Static regulator device improvements may be made to fixed and adjustable weir regulators. However, without moving parts, no opportunity exists for additional control once the weir elevation is set. There are numerous fixed weir regulators in operation within the PWSA.

Swirl / helical, plunge and vortex regulators are dynamic flow devices, and can also be used to regulate flows over a range of head conditions to maximize flow volumes to the interceptors. The swirl/helical, plunge and vortex regulators allow dry weather flow to pass without restriction, but control higher flows by creating a vortex or "swirling" flow pattern. This action limits the peak flow discharged to a receiving water, conduit, storage facility, or treatment facility.

Bending weirs are dynamic flow devices that are counterweight operated. They are typically designed to sustain flow capacities up to a specified head condition. The bending weir collapses when a maximum allowable upstream head condition is exceeded.

Drop structure optimization utilizes similar design principles, and the modifications optimize flow to available sewer capacities in order to control CSO volumes and frequencies.

Inter-basin Flow Balancing / Relief. Flow balancing is a process in which flow is diverted to different basins within a collection system to provide area-specific flow relief. Flow relief provides additional capacity within the collection system in order to minimize local basin surcharging. Flow balancing and relief methods include:

- Inter-Basin Flow Transfer
- Relief Sewers

Inter-basin flow transfer serves to transfer flows from one sewerage basin to another location, such as to another interceptor or to another drainage basin. Basin transfer is implemented when the capacity of a basin's collection system is exceeded and the flow can be routed to a location where additional capacity exists.

Relief sewers are intended to provide additional storage and conveyance capacity to reduce surcharging and to transport wet weather flows. Relief is normally provided by constructing a new conduit parallel to the existing segment that requires relief, with the existing conduit remaining in service. The relief sewer may also function as a replacement conduit if the existing sewer is old or in poor condition. Relief sewer operation may be controlled by a weir that directs dry weather flow into the existing sewer. During wet weather, when the capacity of the existing sewer is exceeded, flow would pass over the weir into the relief sewer. Relief sewers may reduce the need for surface CSO control structures and may also provide an opportunity for rehabilitating aging infrastructure.

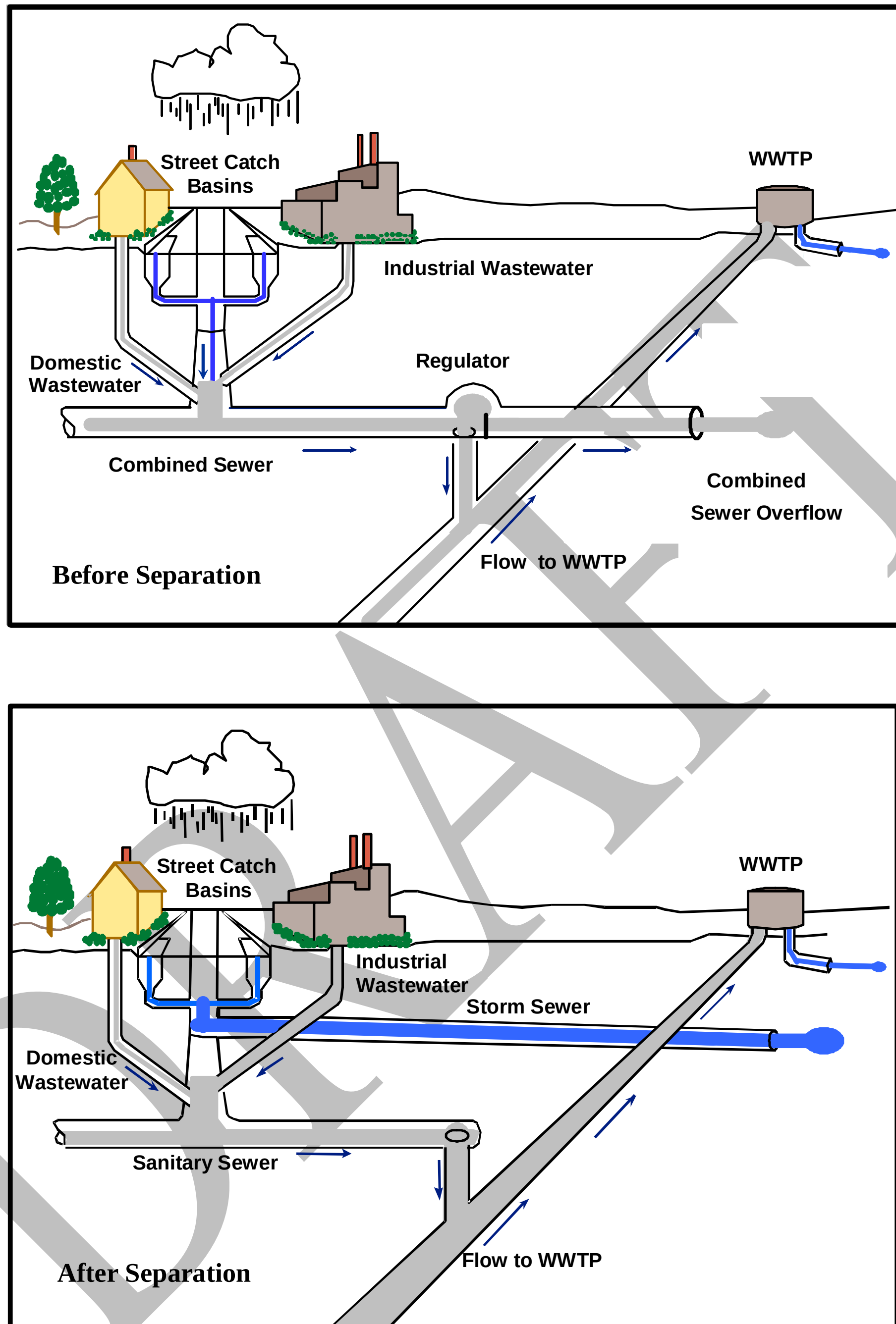
Sewer Separation. In a combined sewer system storm water and sanitary sewage are collected in the same pipe, then it is conveyed to the WWTP. The combined sewer may not have sufficient capacity to convey storm water runoff from all sizes of storms, often causing the mixture of sanitary sewage and storm water to overflow at certain points within the combined system. These overflows are called “Combined Sewer Overflows”, or "CSOs".

In a separate sewer system, pipes conveying sanitary sewage to the WWTP are independent of those pipes that convey storm water to nearby water bodies, eliminating the opportunity for sanitary sewage to overflow to receiving waters. Figure 1 illustrates the typical configurations of combined and separate sewer systems.

Complete or partial sewer separation could be accomplished by constructing new storm drains, and allowing the existing combined sewer to function as a separate sanitary sewer. Separation could also be achieved by constructing new sanitary sewers, allowing the existing combined sewer to function as a storm drain. Using the existing combined sewer as the sanitary sewer allows separate sanitary building connections to remain connected to the "converted" combined sewer.

Complete sewer separation involves the complete removal of storm water inputs to a newly constructed sanitary sewer system. This includes the removal of catch basins, roof drains, footing drains, and all other sources. Partial separation could also be implemented to lower the storm water flows into the remaining combined sewer pipe. This may include separating only the catch basins in a true combined area.

Figure 1. Sewer Separation



STORAGE

Storage technologies for CSO control store excess wet weather flows until sufficient conveyance and treatment capacity is available. Storage technologies include the following:

- In-line Storage
- Subsurface Storage
- Surface Storage

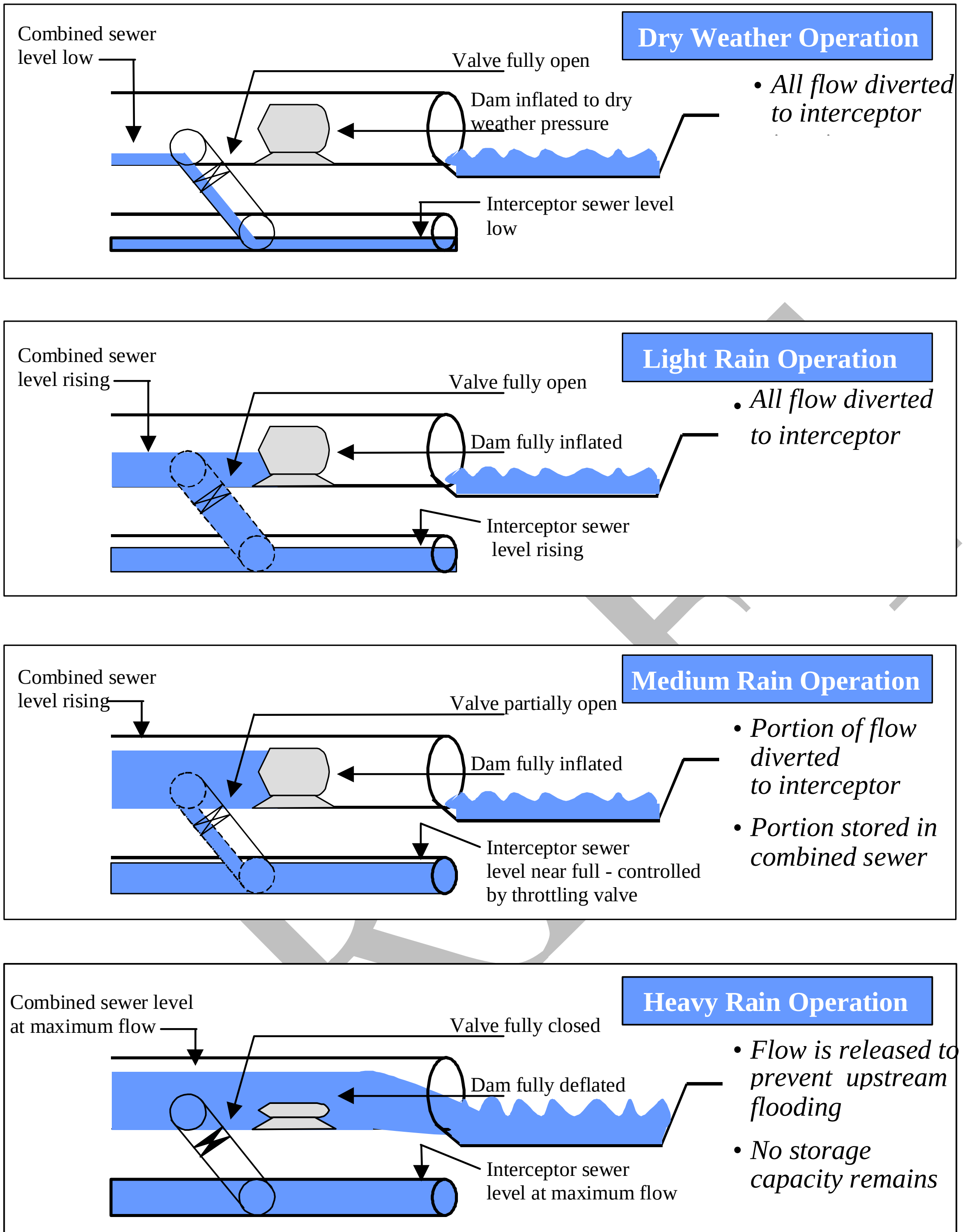
In-line Storage. In-line storage involves technologies that retain flows in the combined sewer collection system and thus reduce the volume and frequency of CSOs. These facilities include:

- Inflatable Dams
- Manual and Automatic Control Gates
- Existing Unused Conduit Storage
- Static Flow Control Strategies
- Variable Flow Control Strategies
- Real-Time Control Strategies

Inflatable dams are reinforced rubberized fabric devices that, when fully inflated, form a broad crested traverse weir. Deflated, the dam contours to the form of the conduit in which it is installed. Figure 2 illustrates an inflatable dam in various operating conditions. The dam could be inflated with air, water, or a combination of both. The dam, which normally remains fully inflated, acts as a regulator by directing flow into an interceptor. It also prevents flow from discharging to an outfall until the depth of flow exceeds the crest of the dam.

Manual and automatic control gates operate in response to local or remote flow or level sensing devices. Normally in the "closed" position, these gates are typically located on overflow pipes to prevent discharge except when upstream conditions warrant (i.e. flooding). Controls are configured to fully open or close the gates, or modulate their position, depending on the desired results. The gates could also be operated in conjunction with global optimal control scenarios.

Figure 2. In System Storage Using Inflatable Dam Operations



Existing, unused conduit storage involves using existing pipes that have been taken out of service for various reasons and re-introducing them as a form of storage. As discussed earlier under regulator optimization, making modifications to fixed weir regulators (static controls) within existing conduits can re-direct flows into nearby abandoned pipes, resulting in additional storage upstream of the regulator structure and a reduction of overflows during small wet weather events. However, the impact on the upstream hydraulic grade line would have to be evaluated so that flooding does not result.

Static flow control strategies include those sewer system BMPs that maximize flow to the treatment plant while minimizing overflows, bypasses, and flooding using simple control devices to develop potential in-line storage. These flow control devices will usually, but not always, be associated with the combined sewer regulators and may include fixed weirs, orifices or static vortex controllers.

Variable flow control strategies utilize dynamic control equipment such as sluice gates, bascule gates or inflatable dams to maximize flow to the treatment plant while minimizing overflows, bypasses, and flooding. Generally, their operational flexibility is greater than that of static controls. Typically, dynamic flow controls are associated with an outfall where the operation of one regulator is not influenced by another in the system. Local control systems use electronic flow or water level monitoring devices that control semi-automatic or automatic regulators.

Real-time control strategies are normally implemented on a global or system-wide scale. Real-time control is a process that integrates control of regulators, outfall gates, and pump station operations based on anticipated flows from rainfall events. Components for real-time control include rainfall data; flow and water level sensors; circuitry and software to transform sensor signals into numerical quantities; circuitry and software to drive the control mechanism (usually gates); rainfall and/or runoff forecasting software; a computer system to collect and control data; and telemetry equipment for communicating data among various regulating structures.

Subsurface Storage. Subsurface storage technologies include the following:

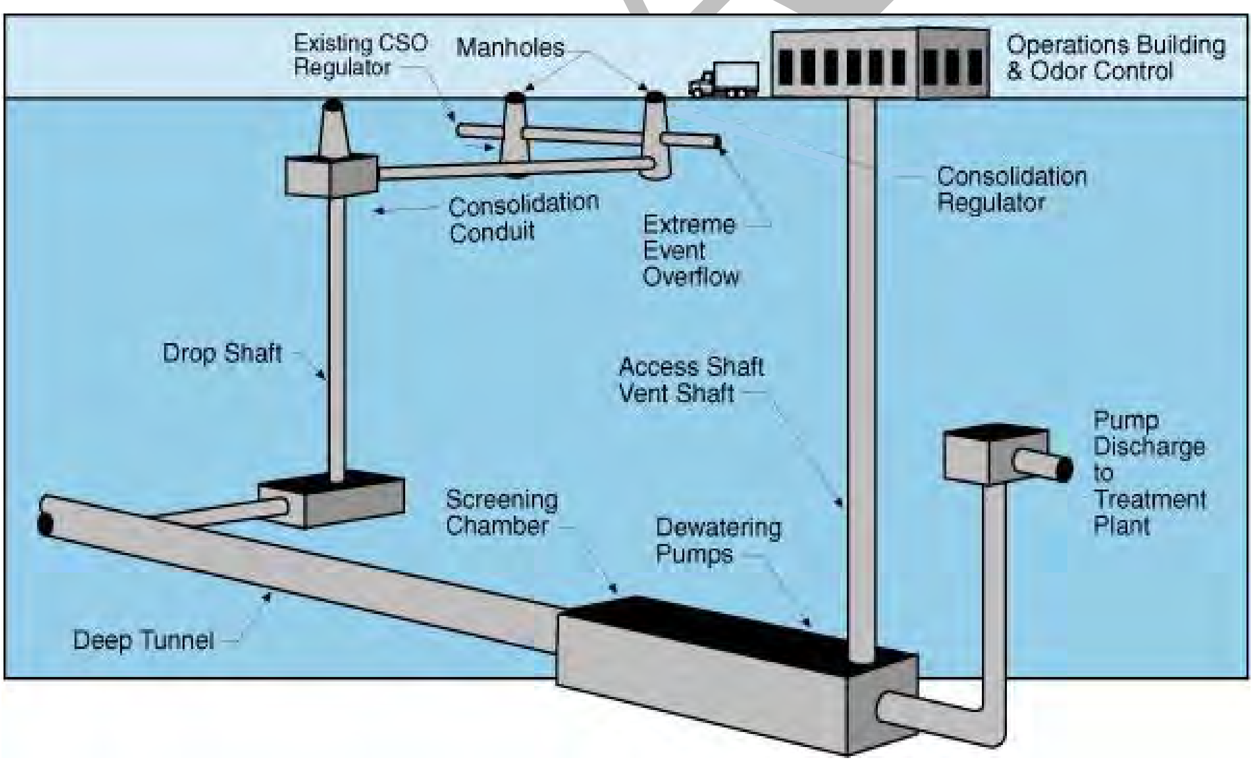
- Tunnel Storage
- Closed Concrete Tanks
- Storage and Conveyance Conduits

Tunnel storage provides storage for large volumes of CSO in below-grade tunnels, as shown in Figure 3. Following a storm event, the stored CSO volume flows by gravity or is pumped back to the collection system for full treatment at the WWTP. If the tunnel storage capacity is exceeded, excess

CSO volume is discharged directly to the receiving water(s). While the size, depth and complexity of a tunnel system varies depending on the location and volume of CSO to be captured and the subsurface conditions, a tunnel system would generally include the following features:

- Vertical drop shafts to deliver flow from CSOs or consolidation conduits near the surface to the deep tunnel
- Coarse bar screens located at each drop shaft or just upstream of the pump system to protect pumps from large objects in the combined flow
- Access shafts to provide personnel and equipment access to the tunnel
- Vent shafts constructed to allow air pressure balancing in the tunnel during tunnel filling or dewatering
- Dewatering pumping system to pump stored combined flow from the tunnel to the collection system or WWTP
- Odor control system located at vent shafts to eliminate odors from the vented air

Figure 3. Subsurface Storage Using Deep Tunnels



Closed concrete tanks are constructed at depths sufficient to bury the structure and that utilize the covered surface for other desired usage(s). Subsurface tanks perform the same function as surface tanks, but often include pumping facilities due to their required depths.

Storage and conveyance conduits utilize tunnels for both the storage of CSO volume and the conveyance of CSO flows to deep tunnel drop shafts. In many locations, it is not practical to connect every CSO location directly to a deep tunnel. Consolidation conduits, constructed at shallower depths, could be used to collect, store and convey flow from two or more CSOs to a single drop shaft more cost effectively than constructing multiple direct connections to the deep tunnel.

Surface Storage. Surface storage facilities include the following:

- Open Concrete Tank
- Earthen Basin

*Open concrete tank*s features a tank or basin that provides storage of CSO. As capacity allows, the contents of the tank would be returned to the collection system for treatment at the WWTP. Surface storage indicates that the facilities are constructed at relatively shallow depths using traditional open-cut excavation techniques. The top of the storage tank is often exposed to the surface. The tank could be constructed out of concrete or as an earthen basin. Flow in excess of the tank volume is diverted to an outfall upstream of the tank.

Earthen basins function in the same manner as concrete tanks, but are formed from earth.

TREATMENT

Treatment technologies are designed to provide pollutant removals from wet weather flows prior to their discharge to receiving waters. Treatment technologies may utilize physical, biological, or chemical processes, or depending on specific treatment goals, these processes may be combined (i.e. physical / chemical) to achieve the desired level of pollutant removal. Available treatment technologies include:

- Suspended Solids Control
- Disinfection
- Floatables / Coarse Solids Control
- High Rate End-of-Pipe Treatment
- Combined Sewer Overflow Treatment Facilities (CSOTF)
- Carbon Absorption
- High Gradient Magnetic Separation (HGMS)
- Constructed Wetlands
- Increased Plant Treatment Capacity

Suspended Solids Control. Available technologies that control suspended solids include the following:

- Microscreens
- Gravity Sedimentation
- High Rate Filtration
- Flocculation / Sedimentation
- Dissolved Air Floatation
- Sand and Organic Filters
- High Rate Sedimentation (Swirl Concentrators, Vortex Separators)
- Coarse Monomedia Filtration

Microscreens have very small openings, generally less than 1/250 inch (0.1 mm), and are intended to provide significant removals of suspended solids and associated BOD, metals, etc. Removal performance tends to improve as influent suspended solids concentrations increase due to the relatively constant effluent concentrations. In addition, screens develop a mat of trapped particles that acts as a strainer, retaining particles smaller than the screen aperture. Chemical additives can be used to improve process removal efficiencies.

Gravity Sedimentation technologies produce a clarified effluent by means of gravitational settling of suspended particles that are heavier than water. It is one of the most common and well established unit operations for wastewater treatment. Sedimentation also provides storage capacity, and disinfection can be applied concurrently in the same tank. It is also adaptable to chemical additives such as lime, alum, ferric chloride, and polymers, which can provide higher suspended solids, BOD, nutrients and heavy metals removal.

Flocculation and sedimentation are commonly used together as a process to coagulate particles (flocculation) and then remove them by gravity sedimentation. Flocculation is used to increase the size and settling velocity of particles within the waste stream, which then increases the solids removal efficiency of the sedimentation process.

Dissolved air floatation technology uses a clarifier for the settling of suspended solids. The air floatation principle is based upon the off-gassing of air from a clean liquid stream that has been introduced into the waste stream. The tiny bubbles formed during the off-gassing attach themselves to the suspended solids, effectively “floating” the solids to the surface of the clarifier. A skimmer is then used to remove the floating material.

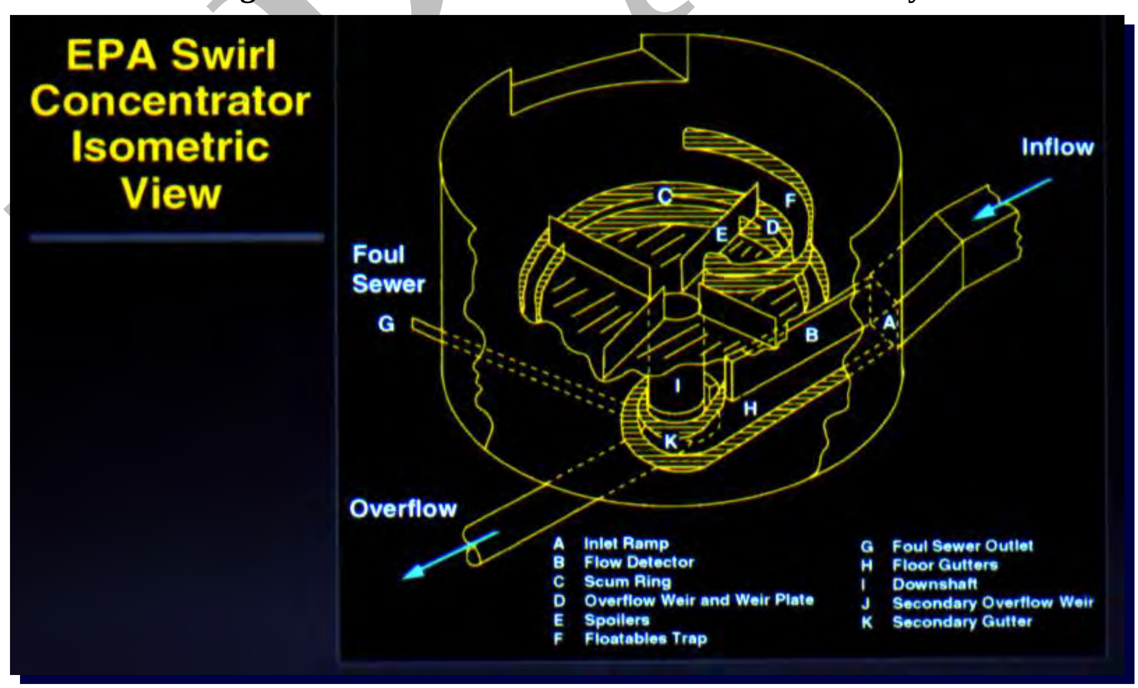
High Rate Filtration typically refers to the use of a filter having two media: anthracite coal and fine sand. Periodic backwashing of the filter bed must be provided to avoid the clogging of the filter media by the suspended solids being removed. High rate filtration has been applied to CSO treatment, but it is more common in the treatment of industrial wastes. Flocculation is often used in conjunction with high rate filtration.

Sand and organic filters, in the form or buffer strips, sand and peat filters and bioretention areas, are design to improve the water quality of small sheet flows from developed areas. The filter is often a thick mat of natural and living materials that slows the flow of storm water, encourages infiltration and provides for the removal of heavy sediment.

High rate sedimentation systems, such as swirl concentrators, vortex separators, and Fluidsep regulate both the quantity and quality of CSO at the point of overflow. These facilities use the inertial energy of the influent along with the annular geometry of a fixed inlet device to simultaneously regulate flow and separate materials of different densities from the influent. The result is a large volume of clear overflow and a concentrated low volume of waste (underflow) that is sent to the dry weather wastewater treatment plant for treatment.

These devices are designed to operate under extremely high flow conditions and have relatively small space requirements. In free-flowing applications, no pumping may be necessary. Prototype units have also been observed to provide effective floatables removal. Due to the minimization of moving parts and relatively low maintenance and space requirements, vortex technologies have been selected by many cities as potential alternatives for CSO control. They could be used as part of an overall treatment system for CSO control. Figure 4 illustrates the characteristics of a swirl concentrator system**.**

Figure 4. Characteristics of a Swirl Concentrator System



Coarse monomedia filtration utilizes a single media source whose average particle size is significantly larger than that used in fine sand filters. Compared to conventional sand filters, coarse sand filters have longer run times, they can store more captured solids, and have higher hydraulic loading rates. Periodic backwashing of the filter bed must be provided to avoid the clogging of the filter media by the suspended solids being removed. Coarse monomedia filtration often incorporates a flocculation step prior to filtration.

Disinfection. Disinfection processes are utilized to selectively destroy disease causing organisms in order to reduce their concentrations to acceptable levels.

Methods used to achieve disinfection commonly include 1) chemical agents, 2) physical agents such as heat and light, 3) mechanical means and 4) radiation mechanisms. Disinfection technologies to be screened for use in these Control Facilities include the following:

- Chlorine and chlorine compounds
- Bromine and bromine compounds
- Ozone
- Microfiltration
- Ultraviolet radiation

Chemical disinfection equipment typically includes chemical storage tanks, metering pumps, a diffuser to disperse the chemical into the flow stream, and automatic controls to regulate the dosage of the disinfectant. Having the appropriate dose rating, mixing, and contact time between the disinfectant and the microorganisms in the flow are all key to achieving sufficient disinfection.

Chlorine and chlorine compounds such as chlorine gas, sodium hypochlorite, chloramines and chlorine dioxide are perhaps the most commonly used chemical disinfectants. All of these leave a chlorine “residual” in the waste stream, i.e. it takes time for them to dissipate once introduced. This “residual” can be quite useful in maintaining low levels of pathogens in transmission systems when required, but it may also combine with organic constituents in the receiving waters, becoming quite harmful to organisms in the waters. Depending upon receiving water quality, the effluent from the Control Facilities may require elimination of most, if not all, of its chlorine “residual”. If so, dechlorination of the effluent may be accomplished via chemical neutralization using sulfur dioxide or sodium metabisulfite, or via adsorption by activated carbon.

Bromine and bromine compounds such as pure bromine, bromine chloride, sodium bromide and bromochlorodimethylhydantoin (BCDMH) can also be used to disinfect CSOs. These compounds provide a more reactive disinfectant than chlorine and its compounds meaning that significantly less chemical must be used. However, they are significantly more expensive than chlorine compounds. All bromine compounds leave a "residual" in the waste stream, which, like chlorine compounds, can be useful in maintaining low pathogen levels in transmission systems. Bromine compounds also combine with organic constituents in the receiving waters. There are conflicting reports as to the toxicity of these bromo-organic compounds, though the effluent from the Control Facilities may still require elimination of most, if not all, of its bromine "residual". If so, de-bromination of the effluent may be accomplished via chemical neutralization using sulfur dioxide or sodium metabisulfite, or via adsorption by activated carbon.

Ozone gas (O_3) is a strong oxidizer. As such, it is a highly effective chemical disinfectant whose use in the wastewater field is continually increasing. Normally, small ozone gas bubbles are dispersed up through the waste stream to ensure maximum contact with pathogens. Unlike chlorine, once ozone is introduced to the waste stream, it dissipates rapidly and leaves no residual. Ozone is a very unstable compound, and it is toxic to humans. For these reasons, ozone gas must be generated on-site, used immediately, and the unused ozone in the off-gas must be collected and disposed of safely.

Microfiltration technologies …

Ultraviolet radiation (UV) is also a strong oxidizer and is highly effective at killing pathogens. Light produced by UV lamps penetrate the cell structures of pathogens and alter the DNA make-up of those cells, prohibiting the organisms from reproducing. UV radiation is commonly applied to the waste stream in a channel where the effluent flow rate can be controlled to ensure irradiation at high intensities and maximum contact times. UV radiation is similar to ozone in that it is toxic to humans, it leaves no residual in the effluent, and it must be generated on-site for immediate use.

Floatables / Coarse Solids Controls are implemented to manage the larger debris existing in combined sewage**.** Floatables controls alone generally can not meet required CSO control goals. Thus, they are considered in conjunction with other coarse solids control alternatives. Several control technologies, including in-line system structural controls and in-receiving water based controls, are available for consideration. Technologies include the following:

- Static Screens
- Mechanical Screens
- In-Line Netting
- Containment Booms
- Regulator Underflow Baffles
- Catch Basin Inserts / Modifications
- Brush Screens
- Continuous Deflective Separation

Static screens are the simplest of all screening mechanisms. Static screens consist of a stationary bar rack or a fine screen placed at an incline perpendicular to the flow stream. With no moving parts, large suspended and settleable solids are removed from the flow stream as it passes through the screening mechanism. Typically, a hydraulic loading rate in the range of 100 to 180 gal/min/ft of width would provide the best removal results. The collected solids are manually removed from the screen for disposal.

Mechanical screens have been developed by a number of manufacturers specifically for CSO floatables control. These screens are intended for use at unmanned sites within sewer systems, and are placed on the overflow or diversion weir. Traditional screens have vertical bars and clear spacing of 0.25 to 1.5 in. Screens are cleaned with various types of rakes that pull trash captured on the front of the bars up along the face of the screen and deposit it into a dumpster or onto a conveyor. Screenings may be disposed of by returning them to the sanitary flow stream for final removal at the downstream sewage treatment facility or by sending them to a landfill.

Traditional mechanical screens generally require construction of a building to conceal the equipment and the solids collected before disposal. They also typically require a staff to maintain the screens and the building. Mechanical screens used for CSO applications typically are associated with other CSO controls. For example, vertical screens provide pretreatment of combined flow entering vortex separators or storage-treatment facilities. These screens are generally not used as stand-alone CSO treatment systems, although their application as an end-of-pipe treatment facility might be applicable on a site-specific basis.

In-line netting is another method of controlling floatables**.** Disposable bags, lifting baskets, and a support frame are housed in a pre-cast concrete chamber installed in line with the overflow between the regulator chamber and the outfall. A secondary bypass screen located above the bags assures 100 percent screening of the CSO under all conditions and prevents surcharging of the sewer system. The secondary screen is inclined towards the direction of flow so that floatables caught on this screen fall into the bags as the water level in the chamber recedes.

Containment booms are floating devices used in the receiving water near an overflow pipe to contain floating materials from CSOs. Solids trapped by these booms must then be collected and disposed of properly. The booms are made of neoprene rubber with a Hypalon external skin, and include an anchoring system to control / restrict the movement of the device.

Regulator underflow baffles consist of a network of transverse baffles mounted in front of, and perpendicular to, an overflow discharge outlet. During wet weather, flow passes under and around the baffles while buoyant materials (the "floatables") are retained behind the baffles. The floatables are then returned to the sewer system for treatment at the wastewater treatment plant.

Catch Basin Inserts / Modifications, such as a "drain diaper", consist of polypropylene fabric held in place by the basin's existing metal grate. The insert collects litter, grease, oil, and other sediment from the storm water before it reaches the sewer system.

Brush screens are a fairly new technology for screening CSO flows at regulator structures. Brush screens are normally made up of a number of horizontal cylinders containing fine bristles that provide solids removal. They are mounted on a center shaft atop an overflow weir, are powered by the influent flow hydraulics, and rotate against the flow. Cleaning of the bristles is achieved by the use of a fixed comb; once "combed" from the bristles, the solids are collected in a trough for disposal back into the system once flows decline. Removal of solids down to 4mm in diameter can be achieved.

Continuous Deflective Separation, or CDS, is a variation of vortex separator technology in which a physical barrier, such as a fine screen (4mm), is combined with the properties of swirling water to provide a continuously cleaning system for the capture of large debris. Though all flows pass through the screen, the continuous swirling action in the unit's sump causes heavier solids to fall to the bottom, keeping them from accumulating on the screen and eliminating the need for a cleaning mechanism. Solids accumulated in the bottom of the sump must be removed at the conclusion of a storm event. This technology is capable of removing small solids and floatables.

High Rate End-of-Pipe Treatment. Ballasted flocculation is a physical / chemical treatment process that utilizes a continuously recycled media, a coagulant, and a polymer to improve floc formation and increase settling velocities of suspended solids. This allows clarification to occur at rates up to ten times faster than can be achieved in conventional clarification units. The end result is a greater treatment capacity in a smaller footprint, which can be ideal for high rate applications such as Overflow controls. Three of the most widely known ballasted flocculation systems currently available are:

- Ballasted Flocculation
- Clarification
- CoMag

Ballasted flocculation systems, such as the ACTIFLO system, are high-rate clarification processes that utilize microsand-enhanced flocculation along with a settling process. The coagulant used is a multivalent salt (ferric chloride or alum). It is mixed with a polymeric flocculent within the microsand. The system is capable of handling a large range of flows and pilot project results show up to 85-95 percent removals of total suspended solids and 60-80 percent removals of BOD.

Clarification systems such as DensaDeg 4D, are high-rate treatment technologies that provides four process functions: grit removal, grease and oil removal, clarification, and sludge thickening. The system provides high rate coagulation, flocculation, and sludge thickening and claims through piloting to provide primary and secondary treatment to wastewater flows.

CoMag is a magneto-chemical high-rate clarification process that utilizes magnetite (small iron granuals) to enhance flocculation, along with a settling process. The coagulant used is normally a multivalent salt (ferric chloride or alum). The system is capable of handling a large range of influent flows and suspended solids concentrations, and can be rapidly be started or shut down depending upon flow fluctuations. Suspended solids concentrations in the effluent can be further reduced by the use of an electromagnet (see High-Gradient Magnetic Separation, below) to remove the remaining magnetite-seeded flocs. The process effectively removes phosphorus, as well as total suspended solids (TSS), biochemical oxygen demand (BOD), color, and turbidity. It has also shown that it can remove pathogens without chemical disinfection.

CSO Treatment Facilities (CSOTF). CSOTFs are near-surface storage / primary treatment technologies used for wet-weather flows at CSO outfalls or at a treatment plant site, and include:

- Storage and Sedimentation Facilities
- Detention and Treatment Facilities

Storage and sedimentation facilities have storage capacity to fully capture a certain volume which can be sent back to a treatment plant after the storm subsides. Flows in excess of the storage tank volume pass through the tank and receive treatment for floatables control, solids removal, and disinfection (if desired). The degree of treatment depends on the rate of flow through the tank.

Detention and treatment systems are similar to storage and sedimentation systems but have a smaller volume and surface area, providing less storage and a lower level of treatment.

While the size of each type of facility varies for a given overflow volume and peak flow rate, the features of each facility are generally similar. At a minimum, the facilities would include screening and a pump station. Influent bar screens (upstream of the tank) and disinfection facilities (if required) should be evaluated for inclusion with these technologies.

"Other" Technologies. A number of additional CSO control technologies exist that cannot be categorized in either of the above groups. These include:

- Sidestream Elevated Pool Aeration
- Carbon Absorption
- High Gradient Magnetic Separation (HGMS)
- Constructed Wetlands
- Existing Treatment Plant Expansion
- Enclose Beach Area

Sidestream elevated pool aeration (SEPA) is a process used to re-oxygenate receiving streams in order to improve water quality. The re-aeration is achieved by pumping a portion of the receiving stream into an elevated pool, returning the diverted water through a series of cascades back to the stream. This approach won the 1994 Outstanding Civil Engineering Achievement Award for the Metropolitan Water Reclamation District of Greater Chicago. Weir loadings of 2.5 cfs/foot at a 3 to 5 foot drop have achieved 95-100% dissolved oxygen saturation, according to published reports.

Carbon absorption technology is a filtration process that uses activated carbon charcoal to remove dissolved organic particles. Absorption takes place due to the intermolecular attraction between the carbon surface and the substance that is being absorbed. As the carrier fluid passes over and through the carbon, the attractive forces cause the entrained compounds that are most attracted to the carbon to be absorbed onto the surface. These compounds are typically organic compounds, volatile organic compounds (VOCs), and halocarbons such as trihalomethane (THM). To avoid clogging the carbon filter, the control of settleable solids, floatables, and coarse solids in the waste stream must be accomplished prior to treatment via carbon absorption. Disinfection facilities (if required) should be evaluated for inclusion with this technology.

High-Gradient Magnetic Separation (HGMS) is a rapid filtration technology that uses fibrous, ferromagnetic coagulation materials to form magnetic flocs with the settleable solids within the waste stream. A strong external magnetic field is then applied to the waste stream, essentially pulling the flocs (and settleable solids) out of the waste stream.

Control of floatables and coarse solids in the waste stream must be accomplished prior to HGMS treatment. Disinfection facilities (if required) should be evaluated for inclusion with this technology.

The CoMag sytem (see description above) utilizes HGMS technology.

Constructed wetlands provide natural treatment for overflows via solids sedimentation, bio-uptake of soluble organics, and the natural reduction of pathogens from the waste stream prior to its discharge to the receiving stream. The size of the wetland is critical to providing adequate waste stream detention time so that all required natural processes may occur. Thus, site constraints become a key consideration for sewersheds located in urban / residential / commercial areas and those expected to produce large overflow volumes. Control of floatables and coarse solids in the waste stream must be accomplished prior to treatment via wetlands.

Existing treatment plant expansion involves increasing the treatment capacity of the existing ALCOSAN facility, allowing additional CSO volume to receive full treatment and reducing the volume of untreated overflows. The current planned expansion of the ALCOSAN WWTP will allow for a maximum wet weather treatment capacity of up to 875 mgd.

Enclosing beach area involves constructing a barrier around the designated usage areas (beaches) to prohibit the migration of pollutants from CSOs onto beaches, causing disruptions and possibly closures. Construction complexity, impacts to receiving waters outside of the barriers, and difficulty of implementation need to be closely considered to develop this technology into a feasible control alternative.

Table 2 - Initial Technology Screening Matrix

Source Control

	Alternative	Result
BMPs	Catch Basin Cleaning	
	Street Cleaning	
	Litter Control	
	Deicer Control	
	Fertilizer & Pesticide Control	
	Hazardous Material Control	
	Industrial Runoff Control	
	Water Conservation	
	Public Education	
	Sewer Use Bylaws	
	Spills Emergency Program	
I / I Control	Sewer & MH Rehab	
	Leader & Footer Discon.	
	Cross Connection Removal	
Storm Water Mgt	U/S Storm Water Storage	
	Porous Pavement	
	Infiltration Trenches & Basins	
	E & S Control	
	Overland Flow Slippage & Catch Basin Restriction	
	Storm Sewer Exfiltration / Infiltration Systems	
	Water Quality Inlets	
	Private Property Storage	
	Pipe Alternives	
	Stormwater Permitting	
	Urban Forest Structure	

Collection System Optimization

	Alternative	Result
Sewer System Opt.	Remove Bottlenecks	
	Sewer Cleaning & Maint.	
	Polymer Injection	
Regulator Opt.	Static Regulator Imp.	
	Energy Dissipaters	
	Bending Weir	
	Drop Structure Optimization	
Flow Relief & Bal.	Inter-Basin Transfer	
	Relief Sewers	
Sewer Sep.	Complete or Partial	

Storage

	Alternative	Result
In-Line	Inflatable Dams	
	Manual & Auto Gates	
	Existing Unused Conduits	
	Static Flow Control Regs	
	Variable Flow Control Strategies	
	Real-Time Flow Control Strategies	
Sub-Surface	Tunnel Storage	
	Closed Concrete Tanks	
	Storage / Convey Conduits	
Surface	Open Concrete Tanks	
	Earthen Basins	

Treatment

	Alternative	Result
Suspended Solids Control	Microscreens	
	Gravity Sedimentation	
	Flocculation & Sedimentation	
	Dissolved Air Floatation	
	High-Rate Filtration	
	Sand and Organic Filters	
	High-Rate Sedimentation	
Floatables & Coarse Solids Control	Static Screens	
	Mechanical Screens	
	In-Line Netting	
	Containment Booms	
	Regulator Underflow Baffles	
	Catch Basin Inserts & Mods	
	Brush Screens	
	Cont. Deflective Separation	
Disinfection	Chlorination	
	Bromination	
	Oxonation	
	Microfiltration	
	Ultraviolet Disinfection	
High Rate End of Pipe	Ballasted Flocculation	
	Clarification	
	CoMag	
CSOTF	Storage and Sedimentation	
	Detention and Treatment	
Other	Carbon Absorption	
	HGMS	
	Constructed Wetlands	
	Existing Treatment Plant Exp.	
	Enclose Beach Area	

CSO Quality Assessment Technical Memorandum June 2007

Pittsburgh Water & Sewer Authority
City of Pittsburgh, Pennsylvania

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Section 1
Introduction

1.1 OBJECTIVES

The objective of this report is to characterize the quality and variability of pollutant loadings of existing Combined Sewer Overflows (CSOs). This analysis is being conducted as part of the development of a CSO Long-Term Control Plan (LTCP) for The Pittsburgh Water and Sewer Authority (PWSA).

The fundamental objective of the CSO LTCP is to control CSO discharges to such a level that the discharges no longer contribute to the non-attainment of receiving water quality standards (WQS). Thus, when evaluating CSO control alternatives in the development of the LTCP, the results of these analyses can be used as the basis from which the water quality benefits of the control alternatives can be calculated.

The PWSA LTCP Team designed their water quality assessment program with two different programs in order to understand how CSO discharges from their service area may impact a receiving stream's water quality. One program, undertaken by the Region 2 Team, focused on sampling and analyzing receiving waters. Its methodology and results can be found in the DRAFT *PWSA Receiving Water Quality Assessment Program Technical Memorandum* submitted to PWSA in December, 2006. The second program, undertaken by the Region 1 Team, focused on Field Sampling at CSO outfalls. Its methodology and results are described in the following sections.

Section 2
Methods and Approach

2.1 OBJECTIVES

The objective of this section is to describe and document the methods and approach used to implement the Field Sampling program. The Program goals were to ascertain and document the existing quality of CSO discharges. This work included the implementation of a water quality sampling program to further characterize end-of-pipe water quality and assessment of the pollutant loadings to the local receiving streams. An understanding of the relative loadings is imperative to developing and evaluating viable CSO control alternatives.

2.2 OVERVIEW

The Field Sampling Program was intended to generate wet weather quality data representative of locations throughout the PWSA service area. The program was designed to sample and test for fecal coliform (FC), five-day carbonaceous biochemical oxygen demand ($cBOD_5$) and total suspended solids (TSS).

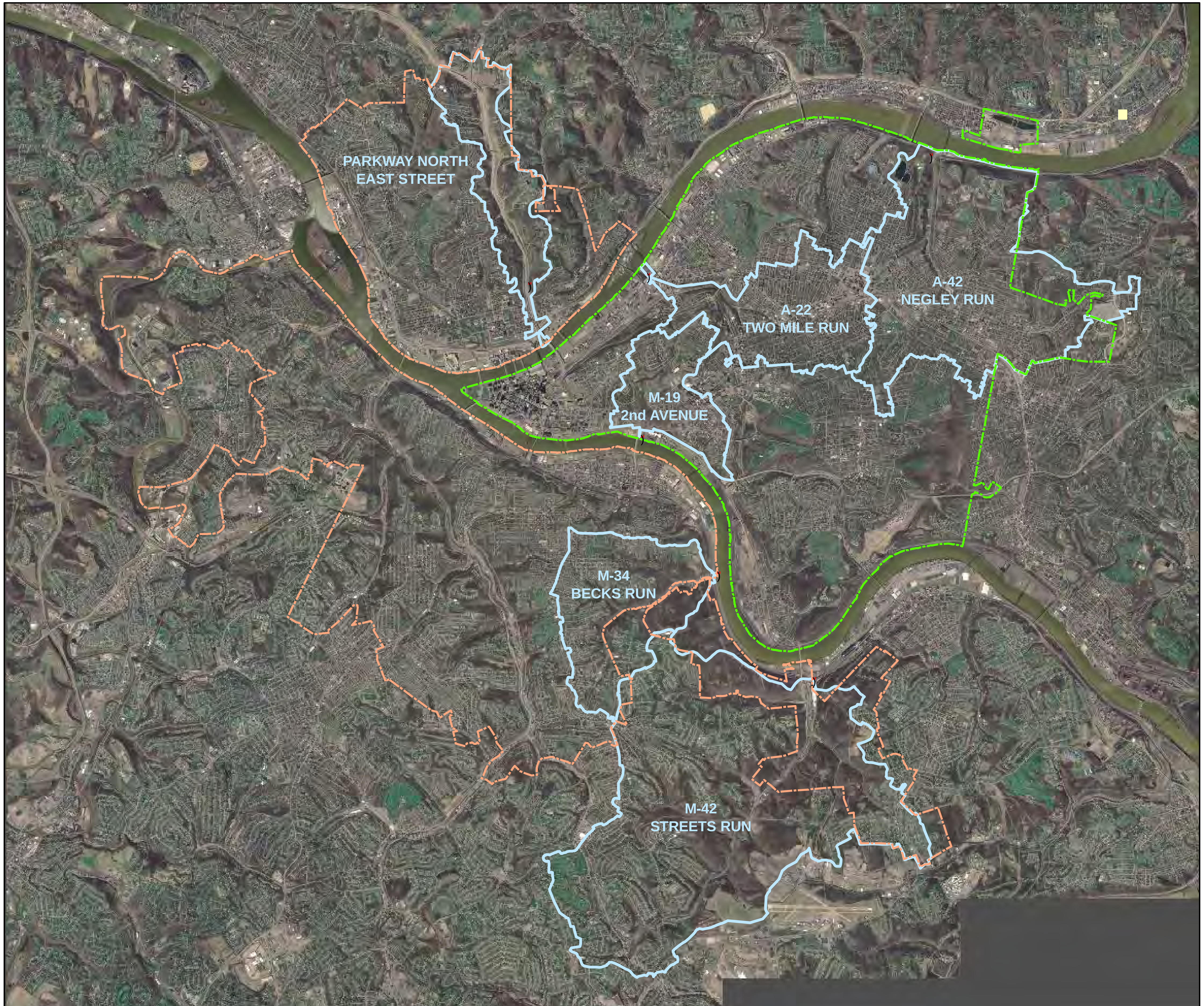
2.3 MONITORING LOCATIONS

The program was carried out during two wet weather events at six CSO locations divided between the Allegheny and Monongahela basins. The sampling locations, and their associated drainage basins, were: Two Mile Run (A22/23), Parkway North, and Negley Run (A42) in the Allegheny river basin, and Beck's Run (M34), Streets Run (M42) and Bates Street (M19) in the Monongahela river basin. The selection of these sites took into consideration the following criteria:

- The site was the location of a significant wet weather discharge.
- The site/outfall was easily and safely accessible. Confined spaces were not considered.
- The site was appropriately configured for sampling.

All sites in the Field Sampling Program were simultaneously sampled at fifteen minute intervals over a four hour period. The time the initial samples were collected was considered to be time t=0, and all subsequent sample times were labeled relative to that time.

The proposed sampling locations were divided between the Allegheny and Monongahela drainage areas. Figure 2-1 shows the six water quality sampling locations and their sewershed boundaries within the PWSA system. Figure 2-2 contains detailed sampling location site maps for each sampling site.



Partnering to achieve long term benefits
PWSA
CSO Team
Metcalf & Eddy Baker/Wade-Trim

Legend

- Sewershed Boundary
- Region 1 Boundary
- Region 2 Boundary
- Sampling Location

Figure 2-1
Water Quality Sampling Locations and Sewershed Boundaries

PWSA
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Quality Water Quality Service

REGION 1 SAMPLING LOCATIONS

A-22
TWO MILE RUN

A-42
NEGLEY RUN

M-19
2nd AVENUE

REGION 2 SAMPLING LOCATIONS

PARKWAY NORTH
EAST STREET

M-34
BECKS RUN

M-42
STREETS RUN

Partnering to achieve long term benefits
PWSA CSO Team
Metcalf & Eddy Baker/Wade-Trim

Legend

Sampling Location

Figure 2-2
Detailed Sampling Location Site Maps

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Quality Water Quality Service

2.4 LAND USE CHARACTERISTICS

The land use characteristics of the watersheds tributary to CSO sampling sites can contribute greatly to the type and quantity of pollutants found in the discharge. The characteristics of each watershed sampled varied by location. Table 2-1 summarizes the predominant land use composition of each monitored watershed.

Table 2-1: Land Use Composition of Monitored Watersheds

	Percent Composition in Watershed					
Label	**A-22/23**	**A-42**	**M-19**	**M-34**	**M-42**	**Parkway N**
Low-Density Residential	8.5%	27.7%	16.5%	46.4%	26.3%	21.7%
Medium-Density Residential	7.3%	10.8%	15.1%	13.1%	17.4%	10.0%
High-Density Residential	78.0%	42.5%	51.3%	11.0%	3.5%	10.2%
Commercial/Identified Malls	1.7%	1.3%	3.4%	0.1%	0.2%	0.7%
Light Industrial	0.6%	0.9%	3.0%	0.1%	0.4%	0.8%
Heavy Industrial	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Transportation	1.4%	1.1%	1.3%	0.1%	1.5%	15.2%
Non-Vegetative	0.1%	0.4%	1.1%	0.1%	0.5%	1.2%
Strip Mine	0.0%	0.0%	0.0%	0.0%	2.1%	0.0%
Forest	2.1%	13.4%	5.4%	25.9%	40.8%	33.2%
Grasslands	0.2%	1.6%	3.0%	3.2%	7.3%	6.8%
Water	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%

The areas tributary to A-22, A-42, and M-19 are predominantly high-density residential with some medium and low-density residential areas present. The watersheds tributary to M-34, M-42, and Parkway North are dominated by low-density residential and forested land use types. The Parkway North watershed also includes a significant fraction (approximately 15%) of land zoned as “transportation”. Commercial, industrial, and other open areas comprised a relatively small fraction of each of the monitored watershed areas.

2.5 DATA COLLECTION

A “primary contact person” was responsible for weather monitoring and the declaration of “storm events”. Collection and testing teams were placed on standby status if the primary contact person determined that a storm producing ½-inch of rainfall in a 24-hour period was possible. When a storm event appeared imminent, this person alerted the appropriate staff and dispatched two staff members to each of the six sampling locations. Once the staff was deployed, and the decision was made to proceed with sample collection, the primary contact person then alerted and coordinated all other parties, including the testing laboratory, in order to coordinate the delivery and analysis of samples. Because the Fecal Coliform samples had holding times of only *six* hours, coordination and lead-time was very important. A sampling team member was assigned to deliver all samples to the laboratory following each wet weather sampling event.

2.5.1 Field Sampling Program Description

Each site was manually sampled at 15-minute intervals during the storm progression, with a maximum of 17 samples being taken per outfall. Table 2-2 lists the samples taken and analyzed under this program.

Table 2-2: CSO Samples Taken and Analyzed

Parameter	No. of Sites	No. Samples per Site	No. of Events	Sample Type
Fecal Coliform	6	17[1]	2	Grab
$cBOD_5$/TSS	6	17[1]	2	Grab

Note: 1. Sample numbers sometimes varied with wet weather event duration

2.5.2 Equipment List

Prior to wet weather field sampling mobilization, the supplies listed below in Table 2-3 were acquired and organized for mobilization to the field.

Table 2-3: Equipment List

Equipment	Quantity	Notes
Insulated Coolers	Two per sample site	Recommended size: 60 to 75 quart
Ice	30 lbs	15 lb per cooler
De-ionized Water	1 liter per sample site	For Equipment Blanks and decontamination
100ml Labeled Sample Bottles (F.C.)	30 per sample site (incl. QC & spares)	Supplied by Laboratory. Refer to Appendices B and C for sample information.
250ml Labeled Sample Bottles ($cBOD_5$/TSS)	30 per sample site (incl. QC & spares)	Supplied by Laboratory. Refer to Appendices B and C for sample information.
Decontamination Supplies	As required	See “Decontamination” below
Rubber Gloves	3 sets per person	PVC and/or Nitrile
Chain of Custody Forms	Two per sample site	One for analytical lab and one spare
Long Handled Dipper / Sampler	One per sample site	Ensure proper length
Flashlights	One per sample site	Include spare batteries
Traffic Control Equipment	As required	Cones, lights, flags, signs etc.
Personal Protective Equipment	One set per person	Hardhat, aprons, safety glasses / face shields, steel toe boots, rain gear etc.

2.5.3 Field Sampling Procedure

Before the team started sampling, a final determination was made by the primary contact person that the storm event was sufficient to gather the required samples. All sites in the Field Sampling program were simultaneously sampled at fifteen minute intervals over a four hour period. The time the initial samples were collected was considered to be time t=0, and all subsequent sample times were based upon that time. The following paragraphs outline the steps completed at t=0 and at each of the following designated times; these times are illustrative only. Sample bottles were placed in a cooler with ice immediately after each sample was taken.

At t=0:

1. Filled one FC sample bottle (supplied by laboratory) and labeled accordingly.
2. Filled one 250 mg sample bottle and labeled accordingly. This bottle would be analyzed for $cBOD_5$/TSS.
3. If “Field Duplicate” bottles were supplied and labeled for t=0, these samples were collected.

4. If "Equipment Blank" bottles were supplied and labeled for t=0, equipment blank samples were taken in accordance with the QA procedures described below. One "Blank" for each of the two testing parameters was required to be taken from each location during each storm event.

The time of the end of sampling was recorded on standard data sheets for each sample. Care was taken to ensure that the samples reached the laboratory in time to allow testing to be completed within required holding times.

2.5.4 Quality Assurance/Quality Control (QA/QC)

During each storm event, specific procedures and protocols were utilized to ensure the quality of samples collected. Testing laboratories were required to analyze the collected samples according to the guidelines described below. The procedures, protocols, and methodologies to be employed for assuring and controlling the quality of the samples collected are covered in the following subsections.

2.5.5 Sample and Collection Container Integrity

The types of sample containers, preservatives, and maximum holding times that were used for the analysis of the sampled media are provided in Table 2-4. The selection of appropriate sample containers and preservatives was dependent on several factors which included the analytical method being performed, laboratory specifications and project specific requirements. The maximum holding times were a function of the parameter to be analyzed and the effectiveness of each preservation technique. Samples were transported to the laboratory/testing area as rapidly as possible to ensure that maximum holding times were not exceeded.

Table 2-4: Sample Containers, Preservatives and Holding Times

Parameter	Container, Plastic (P) or Glass (G)	Preservation	Maximum Hold Time
Fecal Coliform (FC)	P or G	Cool to 4° C	6 hours @ 4° C
$cBOD_5$	P or G	Cool to 4° C	48 hours @ 4° C
TSS	P or G	Cool to 4° C	7 days @ 4° C

New, unused, disposable plastic sample bottles were obtained from the testing laboratory prior to each sampling event.

2.5.6 Sample Handling and Transport

To reduce the potential for contamination of samples or personnel during sample collection and equipment handling, personnel wore disposable poly-vinyl chloride (PVC) or Nitrile gloves. All samples were packaged in ice-filled coolers to prevent breakage and/or leakage while being delivered to the lab/testing area. The coolers were labeled with the name of the laboratory to receive the samples.

Because of the expected non-hazardous nature of the collected samples, packaging and shipping criteria were designed only to maintain preservation and chain of custody protocols and to prevent breakage of the sample containers.

2.5.7 Quality Control While Sampling

To ensure the integrity of samples collected in the field and analyzed in the labs, a number of different quality control samples were submitted for laboratory analysis. Quality control samples, which included equipment blanks and field duplicates, were collected from a different sampling location during each storm event.

Equipment blanks were collected from each of the sampling locations during each monitored storm event. The equipment blanks served to verify the decontamination procedures of the sampling equipment and to verify the adequacy of sample storage methods. The equipment blanks were taken by filling clean lab bottles with de-ionized water. These blanks were then sent to the laboratory to be tested for all parameters.

Field duplicates were collected for each parameter at two locations during each monitored storm event. Field duplicates were defined as two samples collected independently of each other at a sampling location during a single episode of sampling. For example, a field duplicate for $cBOD_5$/TSS incorporated taking a "grab" sample and placing it into a $cBOD_5$/TSS sample bottle. The sampler immediately took another "grab" sample and placed it into a different $cBOD_5$/TSS sample bottle. The second sample's label was identical to the first, with the addition of the words "Field Duplicate".

Analysis of these duplicates provided information related to sample variability and served as a check on the precision of the sample collection methods as it pertained to the sampled area. Field duplicates were analyzed for all parameters.

2.5.8 Data Quality Assurance

Metcalf & Eddy's internal Quality Management System (QMS) was used to ensure that all technical data management aspects of the field sampling activities maintained the quality appropriate for the intended use of the data. This system is compliant with the International Standard Organization (ISO) 9001:2000.

2.5.9 Analytical Quality Assurance

A certified analytical laboratory was utilized for the performance of the analytical testing of the samples. All samples were subject to the following analytical testing guidelines:

Table 2-5: Analytical Methods (Field Sampling)

Parameter	Method Originator	Method ID	Req'd Test Volume (ml)
Fecal Coliform	*Standard Methods*	9222D	100
$cBOD_5$	*Standard Methods*	5210	250
TSS	EPA	160.2	250

2.5.10 Chain of Custody Forms

An overriding consideration essential for the validation of environmental sampling data was the need to demonstrate that samples had been obtained from the stated locations, that they had reached the laboratory without alteration, and that they were subjected to the proper analytical tests. Evidence of the traceability of each sample from initial collection through shipment, laboratory receipt, laboratory analysis, and sample disposal was documented. This was accomplished by use of a “chain of custody” form obtained from the laboratory. An example of a typical form is shown in *Appendix B – Chain of Custody Form*. Custody forms were filled out with information specific to each sampling location prior to each event, and were then taken to each site along with the sampling containers. Each form was then initialed by the appropriate field team member responsible for sample collection, and completed with signatures and transfer date & time of all the individuals responsible for the shipment and analysis of those samples.

Information specific to each sampling location included the sampling location, date, and times; types of samples to be collected along with their unique sample identification numbers; the number of samples to be collected and shipped for analysis in each lot; the project name and number; and the name of the laboratory to which the samples were being sent. A sample was considered to be “in one’s custody” in the following circumstances:

- When in a person’s physical possession.
- When in a person’s view after being in their physical custody.
- When in a locked container after having been in one’s physical custody.
- When in a secured area, restricted to authorized personnel.
- When released, but with the original chain of custody form retained.

2.5.11 Labeling

Field personnel were also responsible for uniquely identifying, labeling, and providing proper preservation and packaging of the samples to preclude breakage or contamination during shipment. All labeling was recorded in indelible/waterproof ink. Any errors were crossed out with a single line, dated, and initialed.

Every sample label securely affixed to the appropriate sample container included the following information:

- Project and site name
- Unique sample identification number

2.5.12 Safety

A Health and Safety Plan (HASP), for use by all personnel involved in the wet weather sampling activities, was adhered to by all personnel. This HASP is included in Appendix C.

Section 3
Data Analysis

3.1 OBJECTIVES

The objective of this section is to describe the collected data and the data analysis used to correlate rainfall data to the water quality and loadings from CSO discharges. The CSO quality data were collected using the methods and approach described in Section 2.

3.2 MONITORED STORMS

Field sampling was undertaken during two storm events. The first event took place around mid-day on September 28, 2006 as a frontal system passed through most of western Pennsylvania, and overflows occurred at all six regulating structures. Five "dry" days, where less than 0.05 inches of rain fell on average, preceded this event. Sampling teams arrived at four of the six sites prior to the initiation of overflows and were able to begin sampling at the onset of overflows at their four sites.

The second event took place on the morning of October 17, 2006. Again, a large frontal system passed through most of western Pennsylvania. As a result, overflows occurred at all six regulating structures. Seven "dry" days preceded this event. Sampling teams arrived at two of the six sites prior to the initiation of overflows and were able to begin sampling at the onset of overflows at their two sites.

Rainfall measurement data for both storm events were downloaded from the 3 Rivers Wet Weather Demonstration Program website (www.3riverswetweather.org). Figure 3-1 illustrates the locations of the rain gauges in or near the PWSA service area, as well as the six sampling locations.

Figure 3-1: Map of 3 Rivers Rain Gauges and Sampling Locations

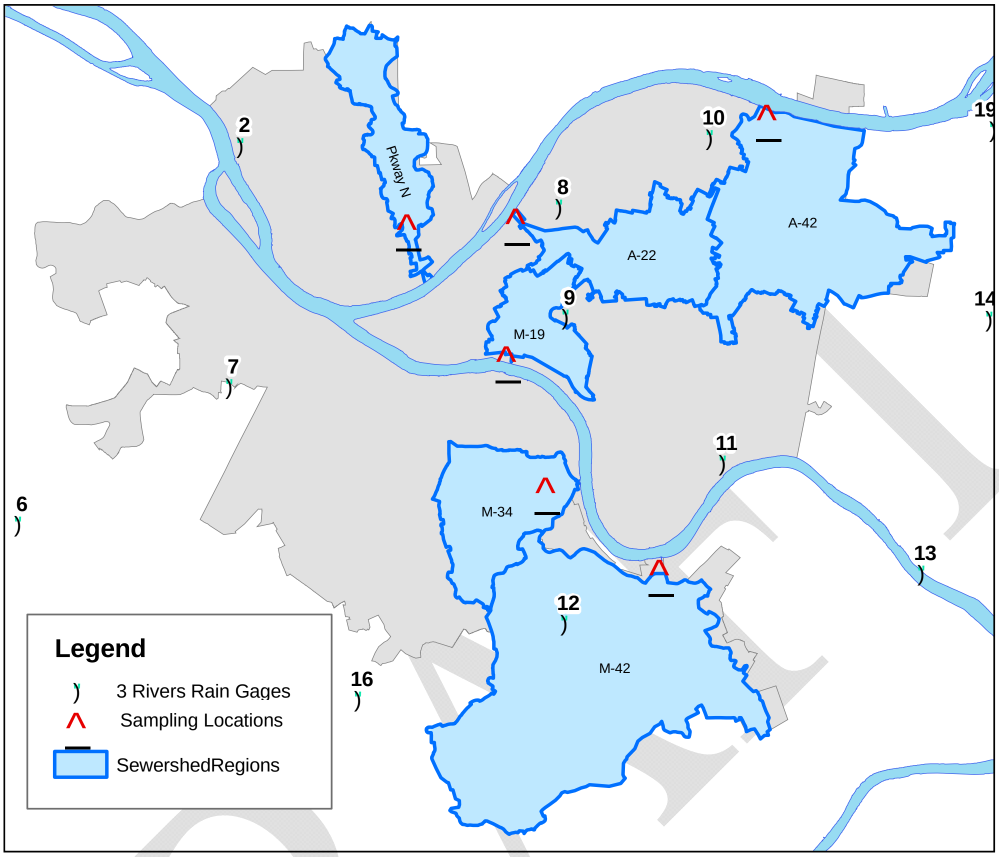


Table 3-1 summarizes the rainfall characteristics for each sampling event as recorded by 3 Rivers rain gauge numbers 8, 9, 10, and 12, which were nearest the six sampling locations. Figures 3-2 and 3-3 show the sample times during each storm event compared to rainfall measured by those gauges.

Table 3-1: Average Rainfall Statistics for 3 Rivers Rain Gauges 8, 9, 10, and 12

Storm Event	Peak Intensity (in./hr)	Total Depth (in.)	# Antecedent Dry Days[1]	Inches before first sample	Inches during sampling
09/28/2006	0.20	0.38	5	0.17	0.22
10/17/2006	0.69	1.62	7	1.22	0.40

1) A day was defined to be dry if less than 0.05 inches of rain fell on average.

Figure 3-2: Sample Times vs. Rainfall - First Storm Event

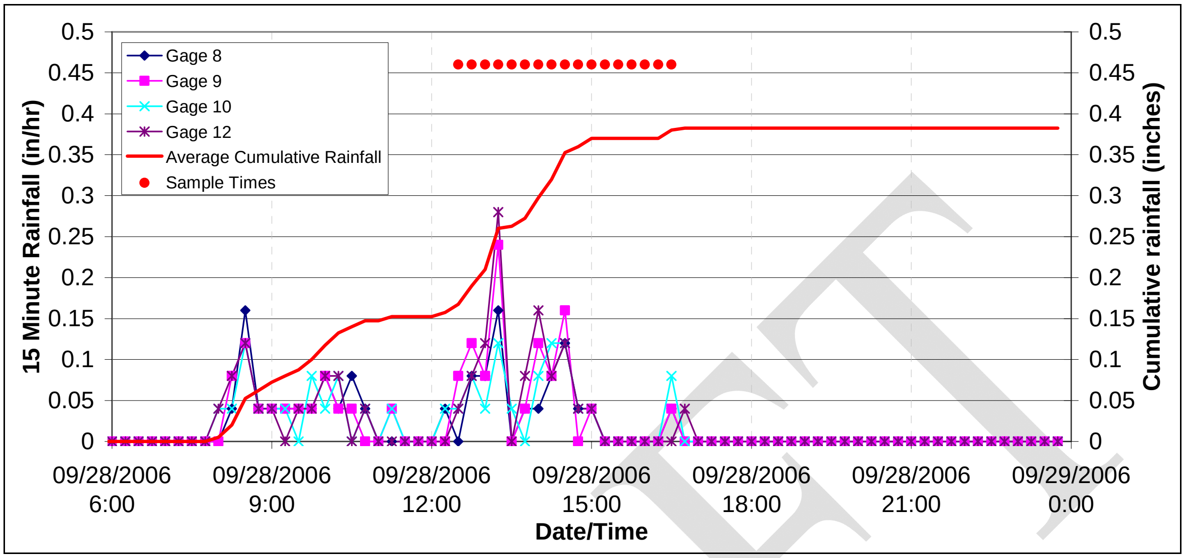
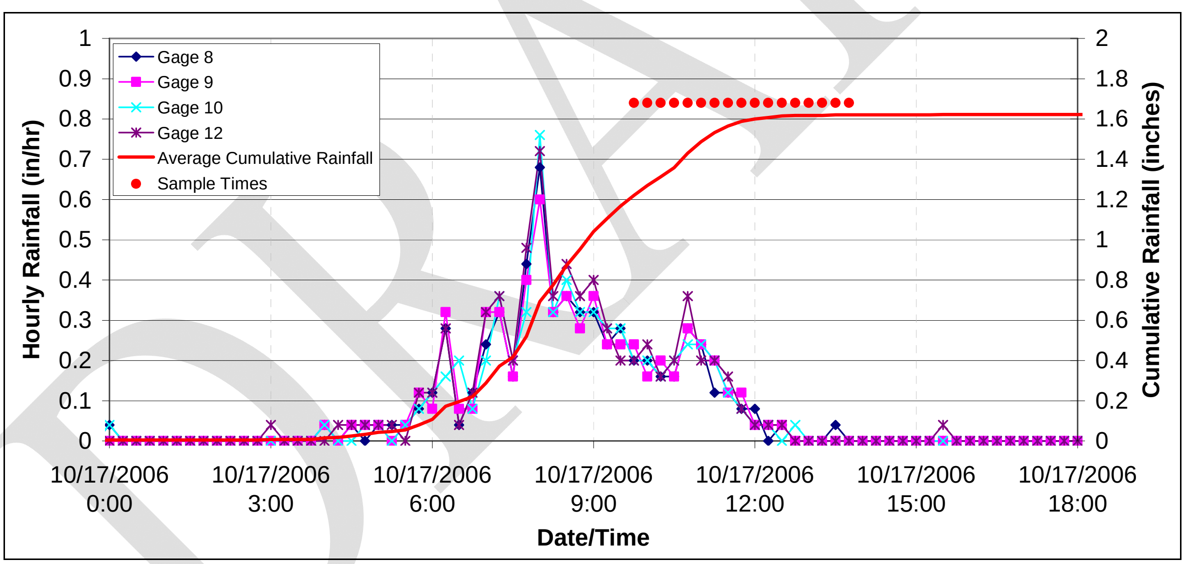


Figure 3-3: Sample Times vs. Rainfall - Second Storm Event



As shown in Figures 3-2 and 3-3, there are significant differences between the timing of the first and second sampling events. Sampling for the first event occurred earlier in the storm event and captured the peak rainfall, whereas sampling did not begin for the second event until after the peak of the storm had passed. Storm Event 1 was a smaller storm; 0.22 inches of rain fell during the monitoring period with approximately 0.17 inches falling before the first measurement. Storm Event 2 was larger with approximately 0.40 inches of rain falling during the sampling period and 1.22 inches falling before the first measurement.

3.3 DATA ANALYSIS

The data recorded at each sampling site was analyzed to determine trends in water quality data and to estimate the event mean concentrations (EMCs) of each constituent at CSO locations. This information was used to help determine the loading of the measured pollutants to the receiving waters within Pittsburgh and Allegheny County.

3.3.1 Raw Data

As many as seventeen measurements were taken for each storm event, at 15 minute intervals. If a sampling time was missed, or if a particular CSO was not flowing during a portion of the sampling time frame, a notation of "N/A" is used.

Tables 3-2 through 3-4 present the raw FC, TSS, and $cBOD_5$ data measured at each location. Table 3-5 summarizes the Mean and Average statistics of the recorded measurements. Field duplicate and equipment blank results are presented in each table, with field duplicate results being "boxed" with their corresponding samples.

The following abbreviations were used for each measurement site:

- NR = Negley Run (A-42) – Region 1
- BR = Becks Run (M-34) – Region 2
- BS = Brady Street (M-19) – Region 1
- ES = East Street (Parkway North) – Region 2
- SR = Streets Run (M-42) – Region 2
- TMR = Two Mile Run (A22-23) – Region 1

Caution should be used when interpreting the data presented in this section, since only two events were sampled. Water quality measurements can vary substantially from storm to storm and two events may not provide enough data to identify significant trends in data.

Table 3-2: Fecal Coliform Data

	September 28, 2006		Fecal (colonies / 100 mL)					
	Minutes	Time	NR	BR	BS	ES	SR	TMR
	Equipment Blanks		20	140	1E+05	10	130	10
	0	12:30	2E+05	3E+06	N/A	1E+03	N/A	2E+06
	15	12:45	1E+06	1E+07	1E+05	N/A	N/A	N/A
	30	13:00	7E+05	9E+06	8E+05	1E+04	5E+06	N/A
	45	13:15	9E+06	1E+07	5E+05	4E+06	2E+06	6E+06
	60	13:30	1E+05	**2E+06**	2E+05	4E+06	1E+06	2E+06
	Field Duplicate			**1E+07**				
	75	13:45	2E+05	4E+06	4E+05	5E+06	2E+06	7E+06
	90	14:00	2E+05	4E+06	3E+06	3E+04	9E+06	4E+06
Event 1	105	14:15	2E+05	5E+06	3E+06	7E+04	7E+06	4E+05
	120	14:30	4E+06	7E+06	5E+04	6E+06	3E+06	**2E+05**
	Field Duplicate							**1.4E+05**
	135	14:45	**6E+06**	5E+06	2E+06	1E+06	3E+06	1E+05
	Field Duplicate		**1E+08**					
	150	15:00	2E+05	9E+06	4E+06	1E+06	3E+06	2E+06
	165	15:15	1E+05	1E+06	2E+05	2E+06	2E+07	1E+05
	180	15:30	8E+06	9E+06	4E+06	2E+06	2E+07	2E+05
	195	15:45	9E+06	9E+06	4E+06	7E+04	2E+07	2E+05
	210	16:00	1E+06	1E+07	1E+06	7E+04	3E+07	1E+05
	225	16:15	2E+06	1E+07	1E+06	3E+04	3E+07	N/A
	240	16:30	N/A	8E+06	3E+07	6E+04	3E+07	N/A
	October 17, 2006		Fecal (colonies / 100 mL)					
	Minutes	Date/Time	NR	BR	BS	ES	SR	TMR
	Equipment Blanks		210	<10	<10	1E+06	4E+06	<10
	0	9:45	N/A	4E+04	4E+04	2E+04	N/A	4E+05
	15	10:00	7E+03	7E+05	9E+04	3E+04	1E+05	2E+06
	30	10:15	4E+03	9E+04	2E+05	3E+05	2E+05	1E+06
	45	10:30	3E+03	2E+05	1E+05	7E+04	8E+05	4E+06
	60	10:45	4E+03	1E+06	3E+05	9E+04	9E+05	5E+05
	75	11:00	9E+04	7E+04	1E+05	1E+04	1E+06	2E+06
	90	11:15	2E+05	2E+05	4E+05	1E+05	5E+05	2E+06
Event 2	105	11:30	9E+04	1E+05	**5E+05**	**2E+04**	2E+06	7E+05
	Field Duplicate				**8E+04**	**2E+04**		
	120	11:45	8E+04	9E+04	1E+05	3E+02	2E+06	2E+06
	135	12:00	2E+05	3E+04	4E+06	2E+03	1E+07	5E+05
	150	12:15	1E+04	3E+05	1E+06	2E+04	1E+07	7E+05
	165	12:30	9E+04	3E+06	7E+05	1E+04	2E+06	1E+06
	180	12:45	1E+04	4E+06	6E+05	2E+03	2E+06	5E+06
	195	13:00	9E+03	3E+06	1E+06	5E+03	4E+06	2E+06
	210	13:15	5E+04	4E+05	1E+06	2E+05	6E+06	9E+05
	225	13:30	9E+03	5E+05	2E+06	4E+04	2E+06	2E+06
	240	13:45	2E+04	6E+04	3E+06	4E+04	5E+06	2E+06

Table 3-3: Total Suspended Solids Data

	September 28, 2006		TSS (mg/l)					
	Minutes	**Date/Time**	**NR**	**BR**	**BS**	**ES**	**SR**	**TMR**
Event 1	Equipment Blanks		<5	<5	<5	<5	<5	<5
	0	12:30	40	40	N/A	35	N/A	N/A
	15	12:45	38	39	160	N/A	N/A	N/A
	30	13:00	188	76	200	110	136	N/A
	45	13:15	244	84	284	75	96	116
	60	13:30	168	**224**	156	48	240	162
	Field Duplicate			**180**				
	75	13:45	156	184	100	48	160	374
	90	14:00	96	168	68	41	208	216
	105	14:15	78	120	60	31	212	204
	120	14:30	98	140	64	32	232	130
	135	14:45	**70**	112	68	28	128	146
	Field Duplicate		**66**					
	150	15:00	50	136	48	34	124	78
	165	15:15	44	84	44	30	88	55
	180	15:30	38	68	52	26	64	51
	195	15:45	32	72	52	20	74	43
	210	16:00	33	48	64	20	66	41
	225	16:15	32	52	72	27	69	N/A
	240	16:30	N/A	48	96	30	63	N/A
	October 17, 2006		TSS (mg/l)					
	Minutes	**Date/Time**	**NR**	**BR**	**BS**	**ES**	**SR**	**TMR**
Event 2	Equipment Blanks		<11	<20	<10	<11	<24	<5
	0	9:45	N/A	55	51	83	N/A	48
	15	10:00	36	45	41	63	112	39
	30	10:15	46	50	59	57	104	39
	45	10:30	33	42	53	58	96	35
	60	10:45	32	49	46	<132	78	33
	75	11:00	35	71	46	59	62	35
	90	11:15	32	83	40	55	64	39
	105	11:30	35	75	**79**	**79**	73	33
	Field Duplicate				**42**	**100**		
	120	11:45	44	51	37	52	69	56
	135	12:00	38	43	38	48	61	37
	150	12:15	34	42	37	45	54	33
	165	12:30	34	47	399	50	53	33
	180	12:45	34	43	69	53	51	33
	195	13:00	34	40	65	56	45	36
	210	13:15	34	47	50	55	47	33
	225	13:30	27	43	59	51	49	38
	240	13:45	29	38	61	59	48	38

Table 3-4: cBOD$_5$ Data

	September 28, 2006		cBOD5 (mg/l)					
	Minutes	**Time**	**NR**	**BR**	**BS**	**ES**	**SR**	**TMR**
Event 1	Equipment Blanks		<2	<2	<2	<2	<2	<2
	0	12:30	28	37	N/A	5	N/A	N/A
	15	12:45	25	42	89	N/A	N/A	N/A
	30	13:00	60	59	97	16	96	N/A
	45	13:15	77	52	75	12	77	81
	60	13:30	47	**89**	63	6	112	86
	Field Duplicate			**83**				
	75	13:45	45	80	49	7	89	88
	90	14:00	35	66	51	6	117	105
	105	14:15	27	57	36	5	116	106
	120	14:30	20	43	28	9	117	58
	135	14:45	**20**	58	29	9	79	43
	Field Duplicate		**19**					
	150	15:00	18	55	29	8	68	23
	165	15:15	17	29	28	7	54	23
	180	15:30	20	31	45	7	50	23
	195	15:45	17	40	49	5	49	29
	210	16:00	32	35	52	5	56	31
	225	16:15	27	39	62	6	47	N/A
	240	16:30	N/A	41	59	6	40	N/A
	October 17, 2006		**cBOD5 (mg/l)**					
	Minutes	**Date/Time**	**NR**	**BR**	**BS**	**ES**	**SR**	**TMR**
Event 2	Equipment Blanks		<2	<2	<2	<2	<2	<2
	0	9:45	N/A	7	15	4	N/A	6
	15	10:00	7	6	12	2	15	8
	30	10:15	11	6	11	4	12	8
	45	10:30	9	7	16	5	15	8
	60	10:45	4	7	13	5	13	8
	75	11:00	7	8	12	5	12	8
	90	11:15	5	17	6	5	13	7
	105	11:30	6	12	**8**	**3**	12	9
	Field Duplicate				**14**	**3**		
	120	11:45	6	8	9	2	10	2
	135	12:00	8	7	12	8	10	4
	150	12:15	8	10	11	6	9	6
	165	12:30	8	8	11	4	8	6
	180	12:45	9	8	16	5	9	6
	195	13:00	8	9	38	5	8	13
	210	13:15	11	9	24	4	11	16
	225	13:30	10	10	21	4	8	17
	240	13:45	11	8	32	7	7	18

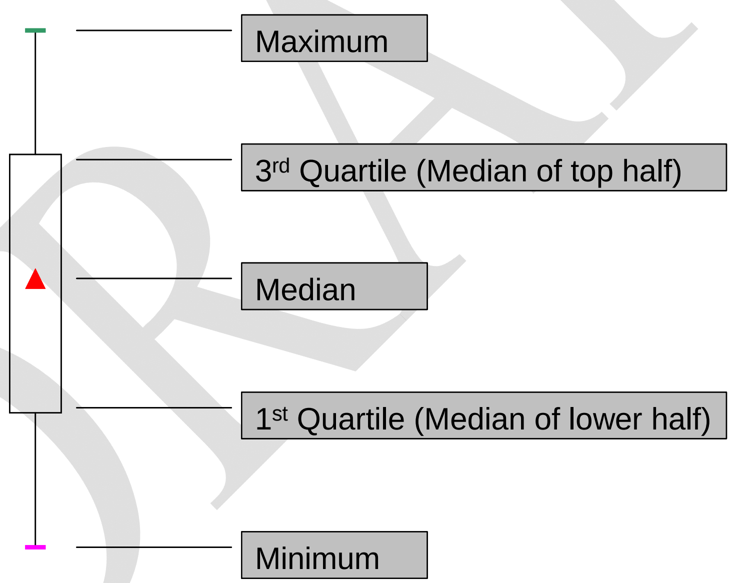
Table 3-5. Mean and Average Statistics for Each Measured Constituent

Constituent	Statistic	Event 1	Event 2	All Events
Fecal Coliform	Geometric Mean	1.4E+06	2.2E+05	5.3E+05
	Arithmetic Mean	4.6E+06	1.1E+06	2.8E+06
	Median	2.2E+06	3.0E+05	9.0E+05
TSS	Arithmetic Mean	97	54	75
	Median	71	47	52
CBOD5	Arithmetic Mean	46	9	27
	Median	42	8	12

3.3.2 Analysis of Fecal Coliform Data

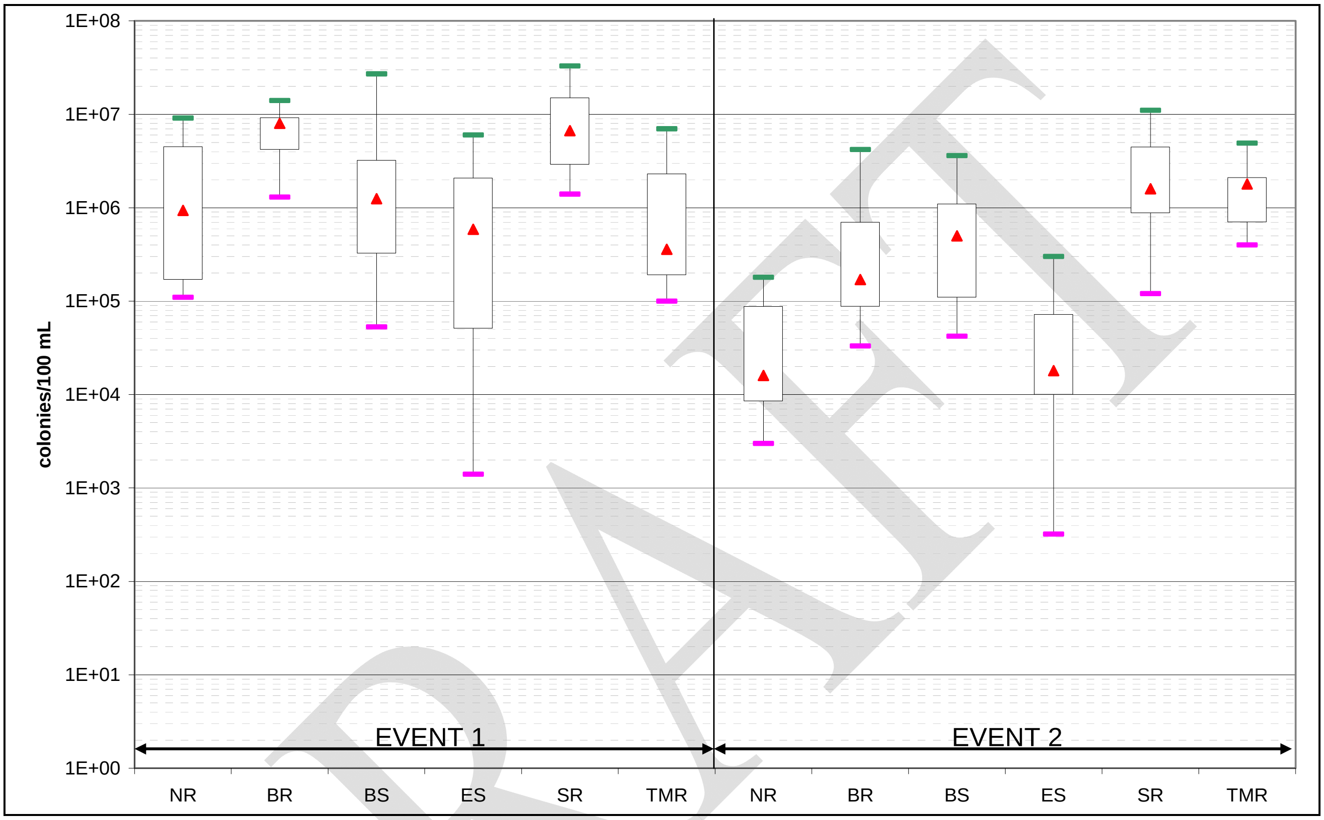
Box plots of measured data were created to illustrate the "spread" of data within a group of measurements by dividing the data into "quartiles". Figure 3-4 below is a diagram showing how to interpret a box plot.

Figure 3-4: Illustration of Box Plot



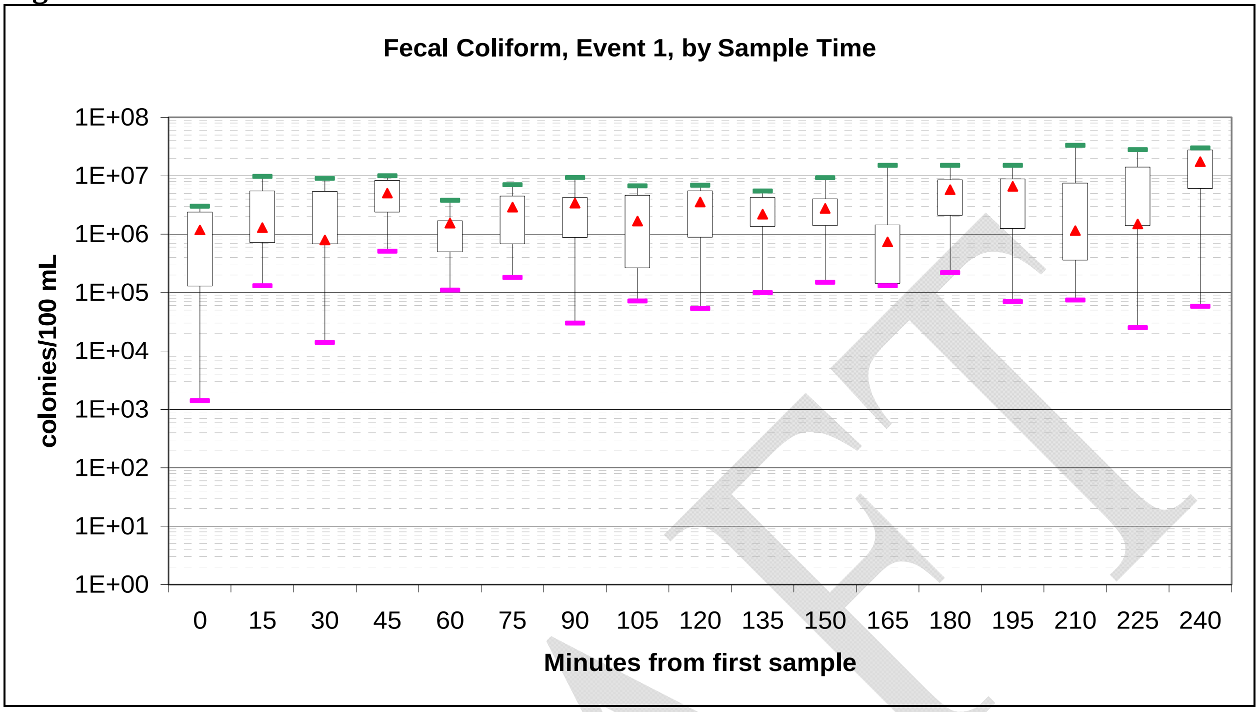
Figures 3-5 below is a box plot of FC data from both events, plotted as a function of sampling location. Figure 3-6 below is a box plot of FC data from both events plotted as a function of time. In both plots, FC data is plotted on a log scale. The purpose of these plots is to illustrate potential influences on the data from either the sampling location or the rain event. The plots in Figure 3-6 indicate that FC concentrations varied relatively little during the sampling events.

Figure 3-5: Box Plots of Fecal Coliform as a Function of Event and Location

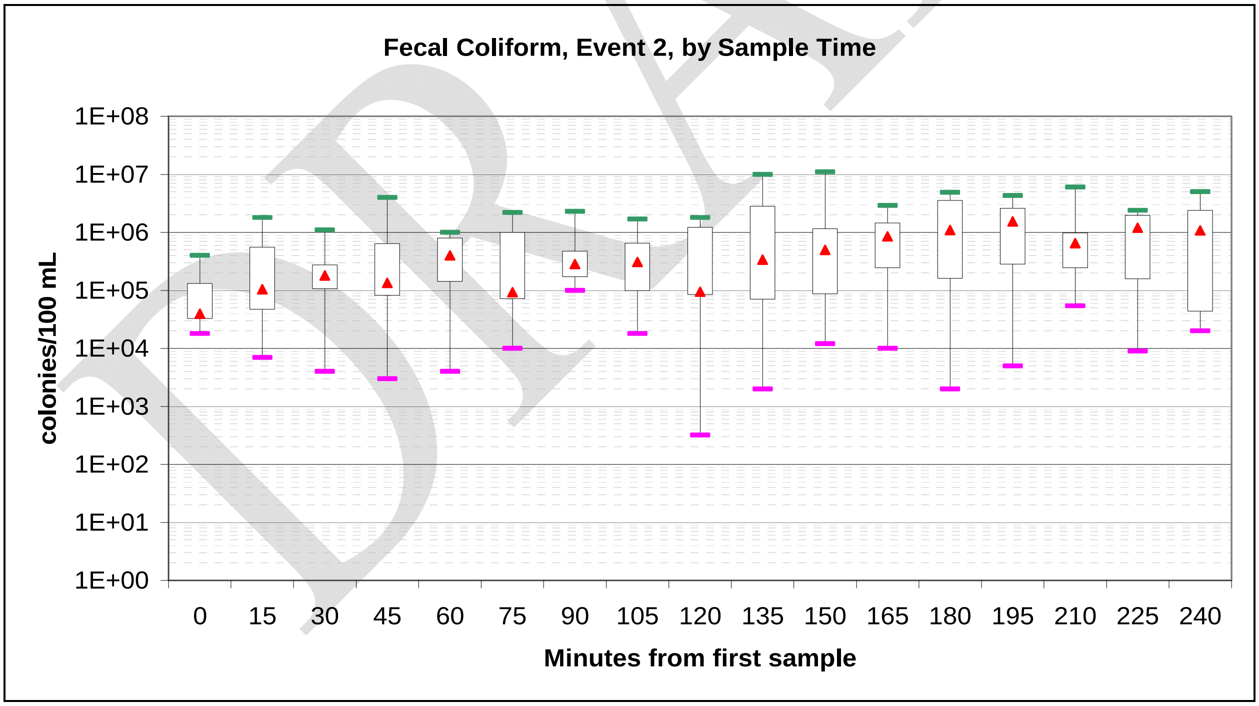


Note: each box represents the range of values observed at each location over the sampling period.

Figure 3-6: Box Plots of Fecal Coliform as a Function of Time



Note: each box represents the range of values observed at each of the six locations at that time.



When the land uses within drainage basins associated with each sampling location were compared to the FC results, it was observed that basins having a higher percentage of forested area (BR, SR, and ES) did not show significantly different concentrations of FC compared to other basins. The lowest concentrations of FC were found in the basin tributary to the Parkway North (ES); this basin also had the lowest percentage of residential area. It is not clear from the data if these differences in land use are significant to FC concentrations, but it is not anticipated that they would be becuse concentrations of fecal coliform in sewage are significantly higher than those concentrations found in stormwater.

In general, Event 2 showed lower concentrations of FC compared to Event 1. These lower concentrations are likely due to the significantly larger volume of rainfall delivered by Event 2, causing dilution of the sanitary component of the flow. These lower concentrations may also be related to the timing of the sampling during Event 2, which was initiated after the peak of the storm had passed. As a result, no samples were taken during the "first flush" of the system, when pollutants (including FC) that have settled within the piping system get re-suspended by the high flows. However, since concentrations of FC are generally lower in stormwater than in sewage, any "first flush" of FC would likely be negated by the dilution effect of the stormwater during the "flush".

Results obtained from the Equipment Blanks from Bates Street (Event 1), Streets Run and East Street (Event 2) ranged from 150,000 to 4,000,000 colonies/100ml. Potential means of contamination include the production of the samples in the field, placement of the samples in ice/water-filled coolers where they could become submerged in contaminated water, and during the laboratory analysis. The exact cause was not able to be determined; however the presence of consistently high fecal coliform counts across all sites and at all time intervals was enough to conclude that significant levels of bacteria exist in overflows from all six sites. As such, the analysis of the fecal coliform data was performed as planned.

3.3.3 Analysis of Total Suspended Solids Data

Box plots were created using TSS measurements. Figure 3-7 contains box plots of TSS concentrations during each event as a function of location. As with FC, areas with more forested land (BR, SR, and ES) did not seem to show significantly different concentrations compared to other areas.

With the exception of Parkway North, Event 2 exhibited lower concentrations of TSS compared to Event 1. As with FC, this may be due to the larger volumes of stormwater present during the second event. The lower concentrations during Event 2 may also be due to missing the "first flush" of pollutants since sampling during the second event occurred later in the storm compared to Event 1.

Figure 3-8 shows TSS concentrations during each event as a function of time. The box plots for Event 1 indicate that there may be a first flush of TSS early in the storm event, since the first three hours of measurements indicate a clear increase and subsequent decrease in TSS concentrations. This trend was not observed during Event 2, which may be the result of missing the "first flush"; however, differences in concentrations may be attributable to the occurrence of natural variations between events.

Results obtained from the TSS equipment blanks were low enough to conclude that contamination of those samples did not occur during the production of the samples in the field, the transport of the samples to the lab, or during the laboratory analysis.

Figure 3-7: Box Plots of TSS as a Function of Location

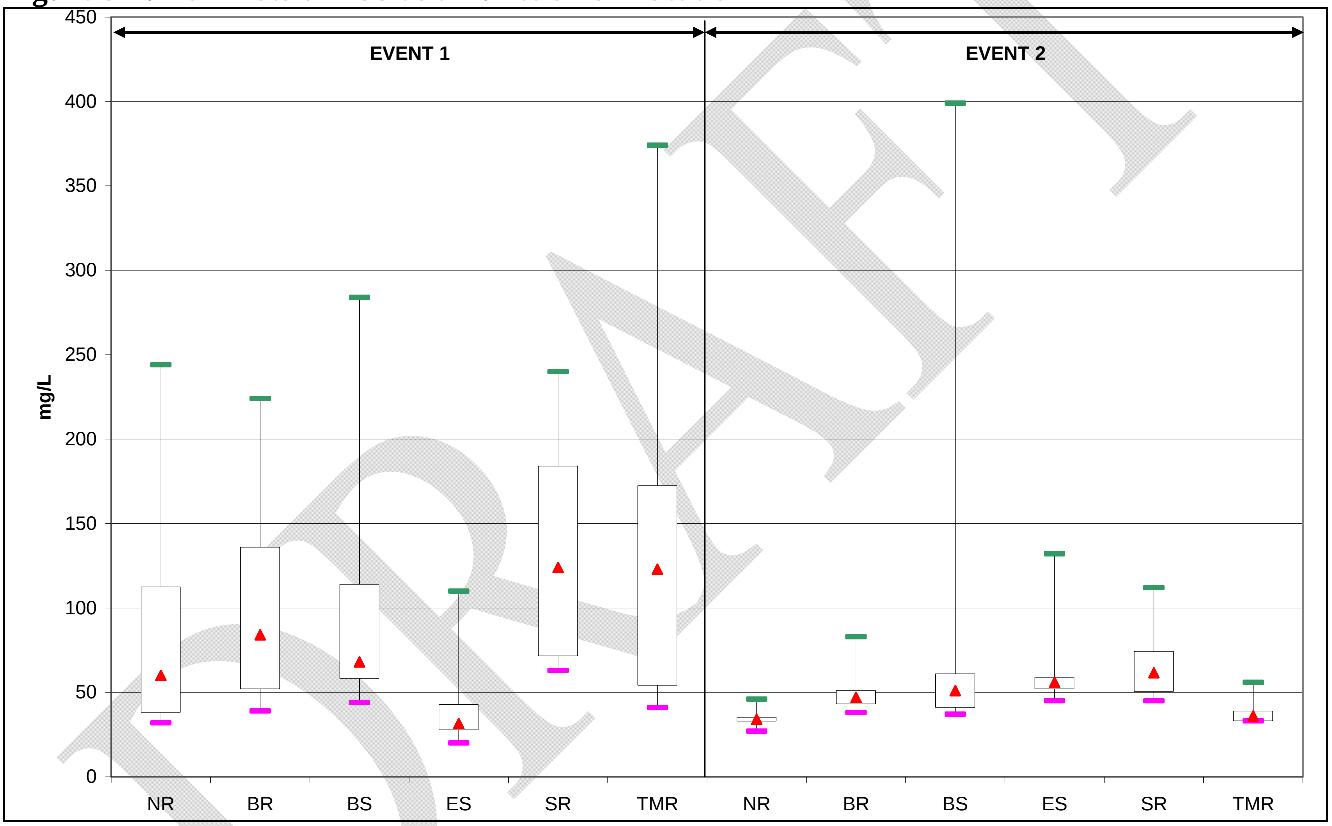
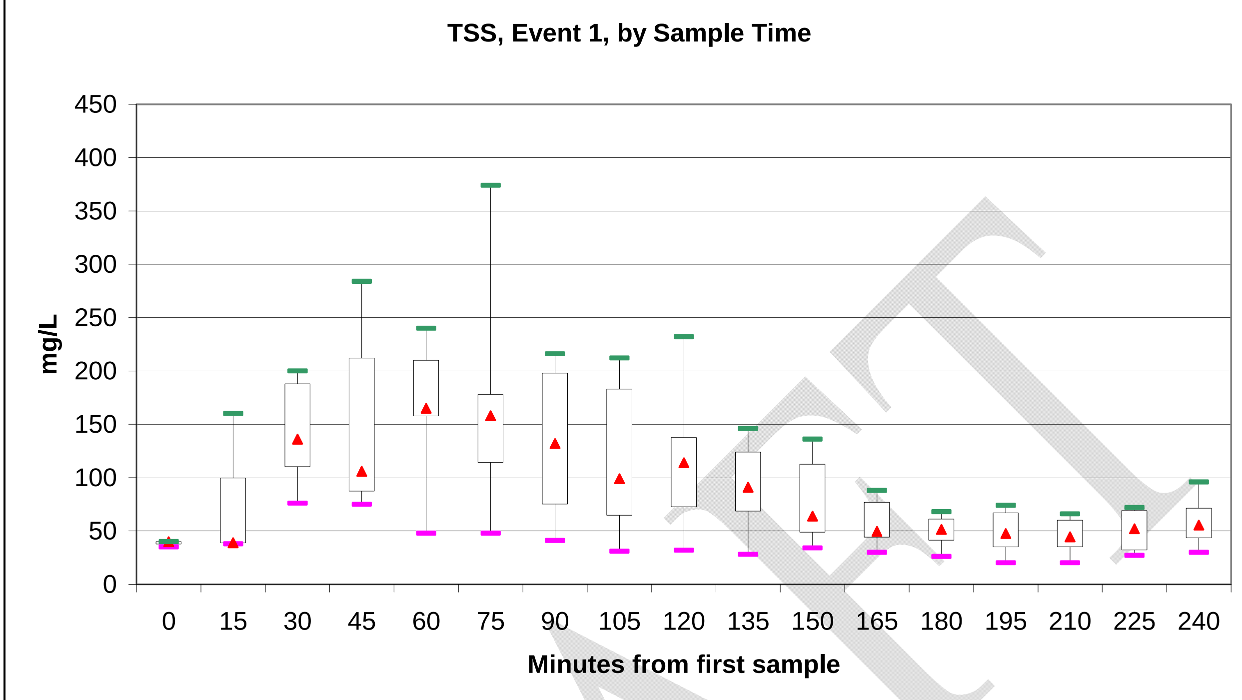
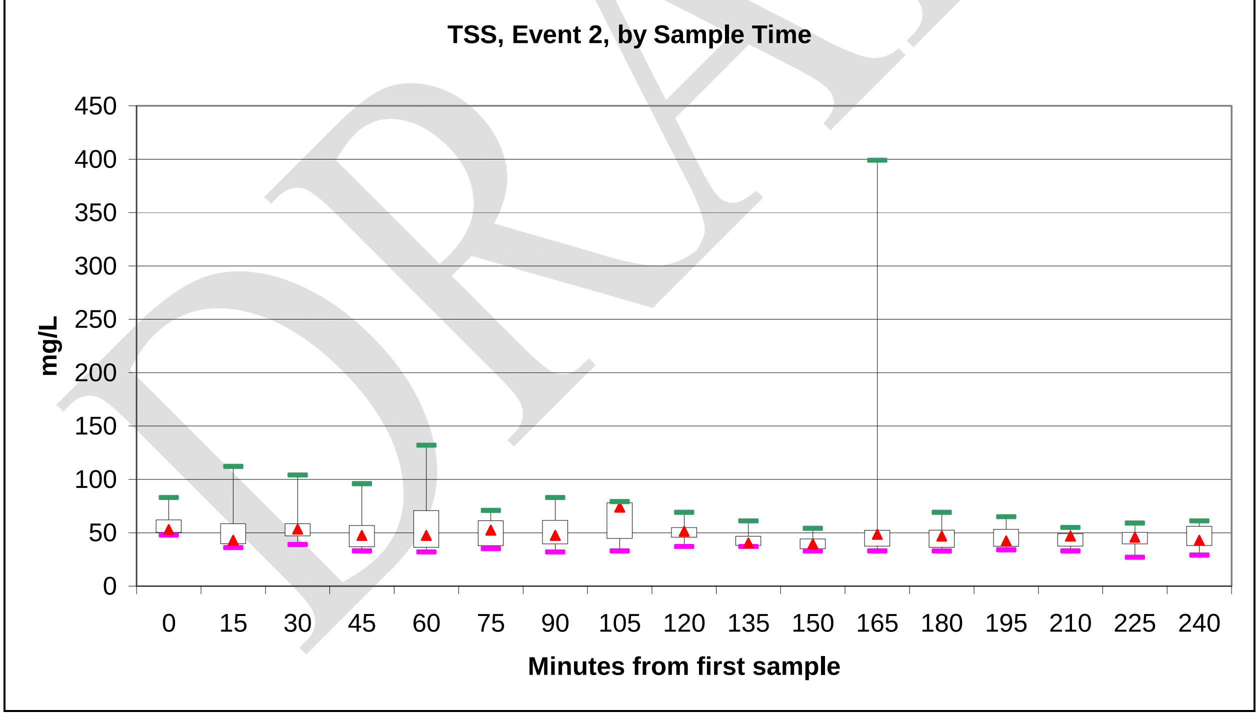


Figure 3-8: Box Plots of TSS as a Function of Time





3.3.4 Analysis of $cBOD_5$ Data

Similar box plots were generated for $cBOD_5$ measurements. Figure 3-9 shows measurements of $cBOD_5$ for both events as a function of location. For both events, the lowest measurements came from Parkway North (ES). Again, land use did not seem to influence the results.

Measured $cBOD_5$ levels were significantly higher during the first event than the second event. Event 2's lower concentrations were likely due to dilution caused by larger stormwater volumes, missing the potentially higher concentrations of "first flush" samples, or a combination of both reasons.

Figure 3-10 shows $cBOD_5$ concentrations for both events as a function of time. As with TSS, there is a clear increase, and subsequent decrease, in $cBOD_5$ concentrations during the first storm event; this feature was not observed during the second storm event. It should be noted that unlike the plots of TSS, "baseline" $cBOD_5$ values for the first event were higher than concentrations measured during the second event. For TSS, concentrations at the beginning and end of the first event were relatively close to TSS measurements taken during the second event (~50 mg/L). However, the beginning and ending $cBOD_5$ concentrations for the first event (~20-40 mg/L) are more than double the measurements taken during Event 2 (~10 mg/L).

Results obtained from the $cBOD_5$ equipment blanks were low enough to conclude that contamination of those samples did not occur during the production of the samples in the field, the transport of the samples to the lab, or during the laboratory analysis.

Figure 3-9: Box Plots of $cBOD_5$ as a Function of Location

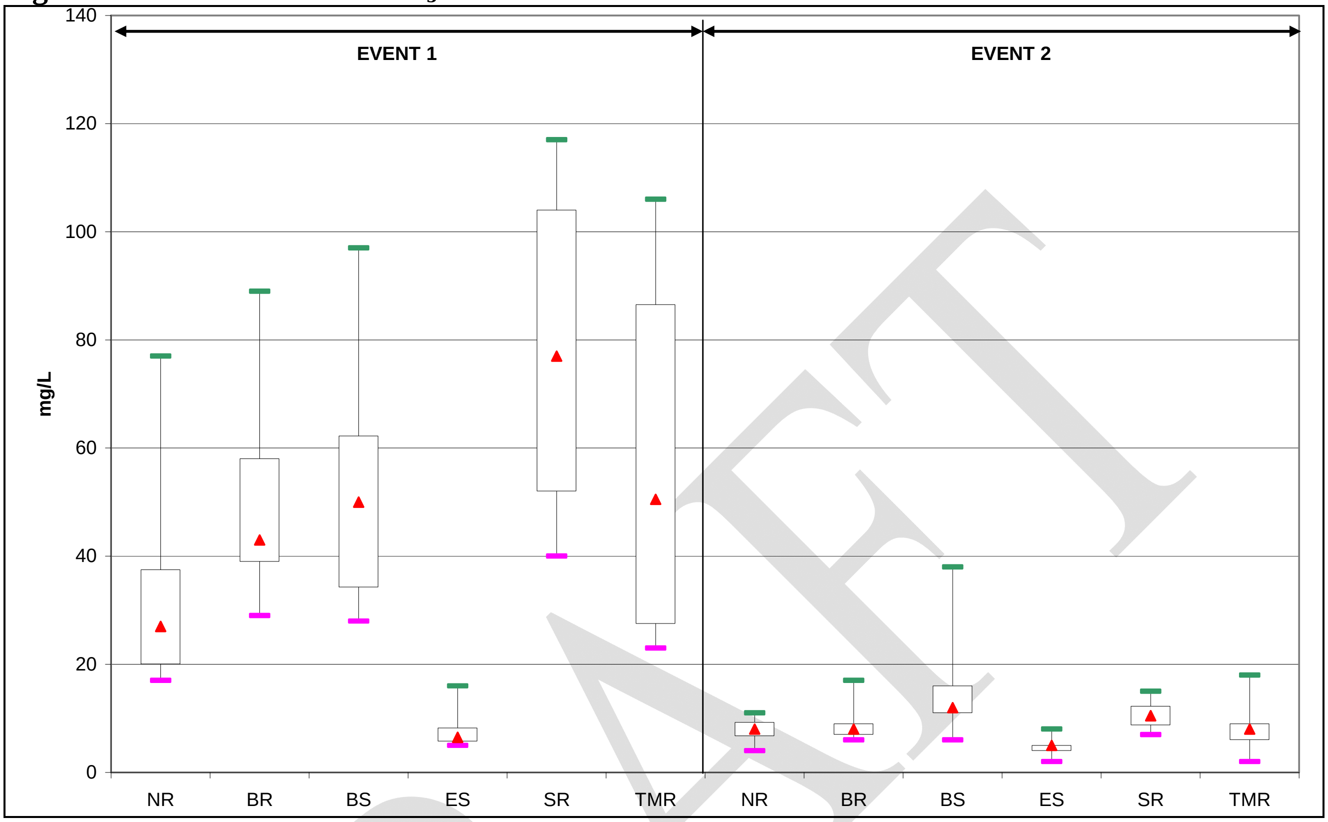
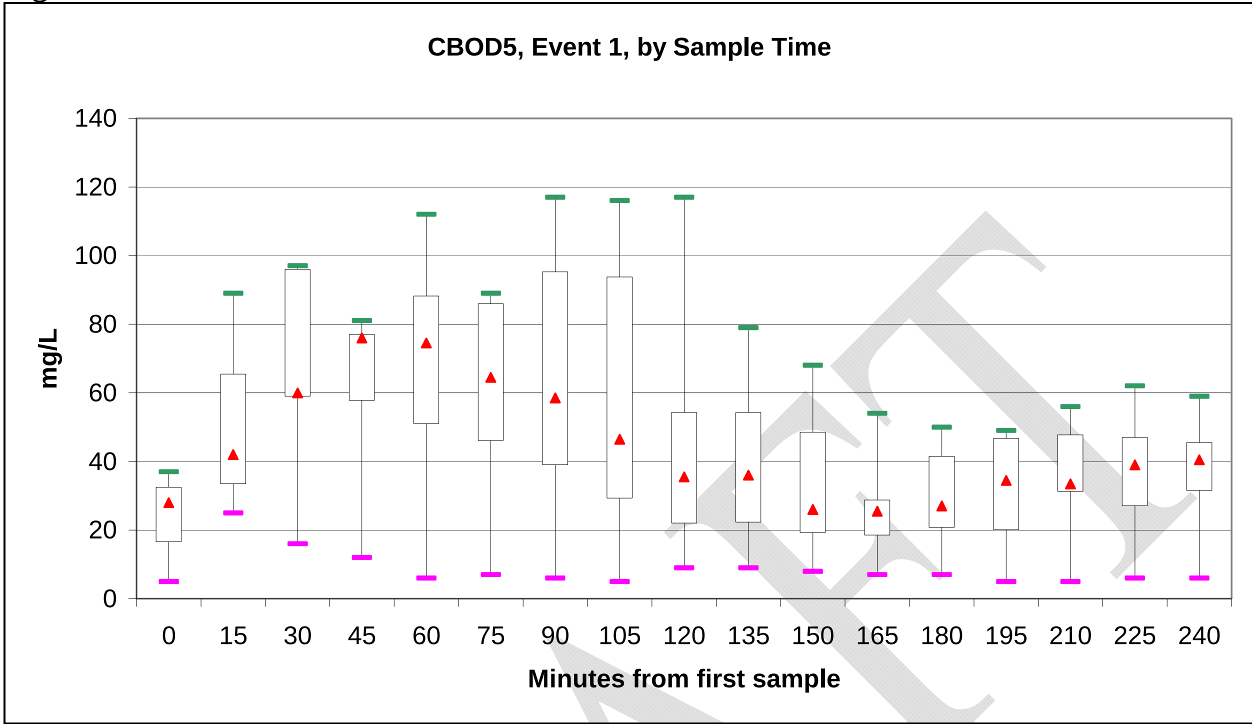
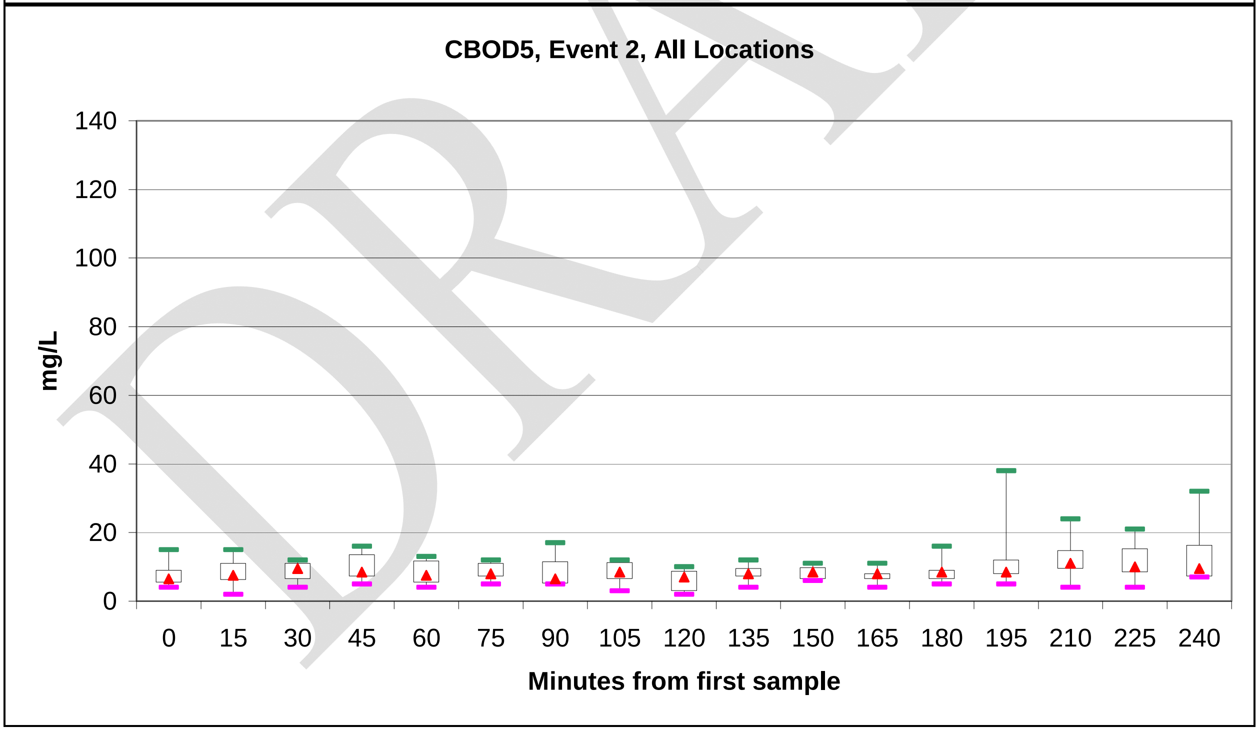


Figure 3-10: Box Plots of $cBOD_5$ as a Function of Time





3.3.5 Event Mean Concentrations and Loadings

The measurements detailed above were further analyzed to develop event mean concentrations (EMCs) for each constituent. EMCs represent the pollutant contributions, in mass per unit volume (mg/L), of CSOs. Since measurements were taken only periodically throughout the storm event, these EMCs represent average concentrations during the sampling period only, roughly corresponding to the peak of each storm.

In order to develop EMCs for each measurement location, establishing the relationship between overflow rates and time at each sampling location was required. To obtain estimates of overflow rates, the rainfall data obtained from the 3 Rivers demonstration program was entered into a calibrated hydraulic and hydrologic model of the PWSA collection system. This model, built around the InfoWorks CS program, was used to estimate overflow rate versus time at each measured regulator.

Currently, the PWSA model is not integrated with the ALCOSAN interceptors in the InfoWorks model. Therefore, an assumption was necessary to estimate the influence of downstream conditions on CSO volume. For the purposes of this analysis, it was assumed that the dry weather connection would pass up to peak dry-weather flow. Anything exceeding peak dry weather would become an overflow. One regulator (M-19) did not have predicted overflows during the part of the first sampling event. In this case it was assumed that the regulator would pass 95% of the peak dry weather flow.

Figures 3-11 and 3-12 are graphs of predicted flow versus time at each sampling location. The time span covered by these graphs corresponds to the time frame during which the field sampling occurred.

Figure 3-11: Flow vs. Time at Each Sampling Location - Event 1

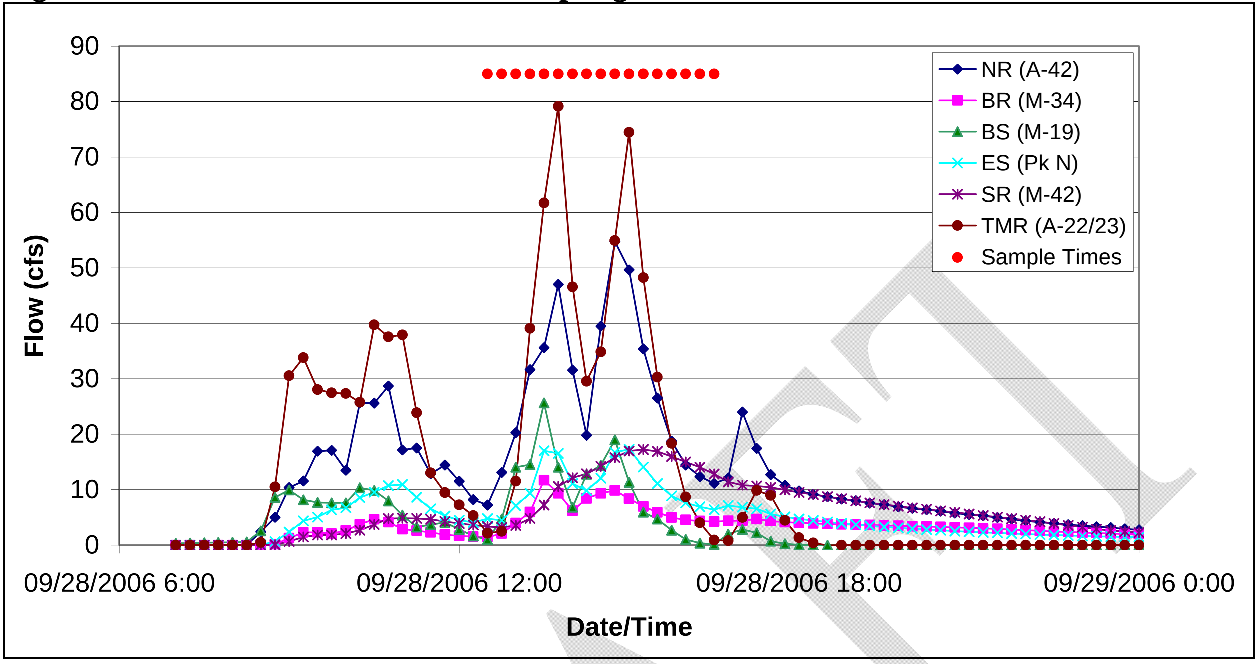
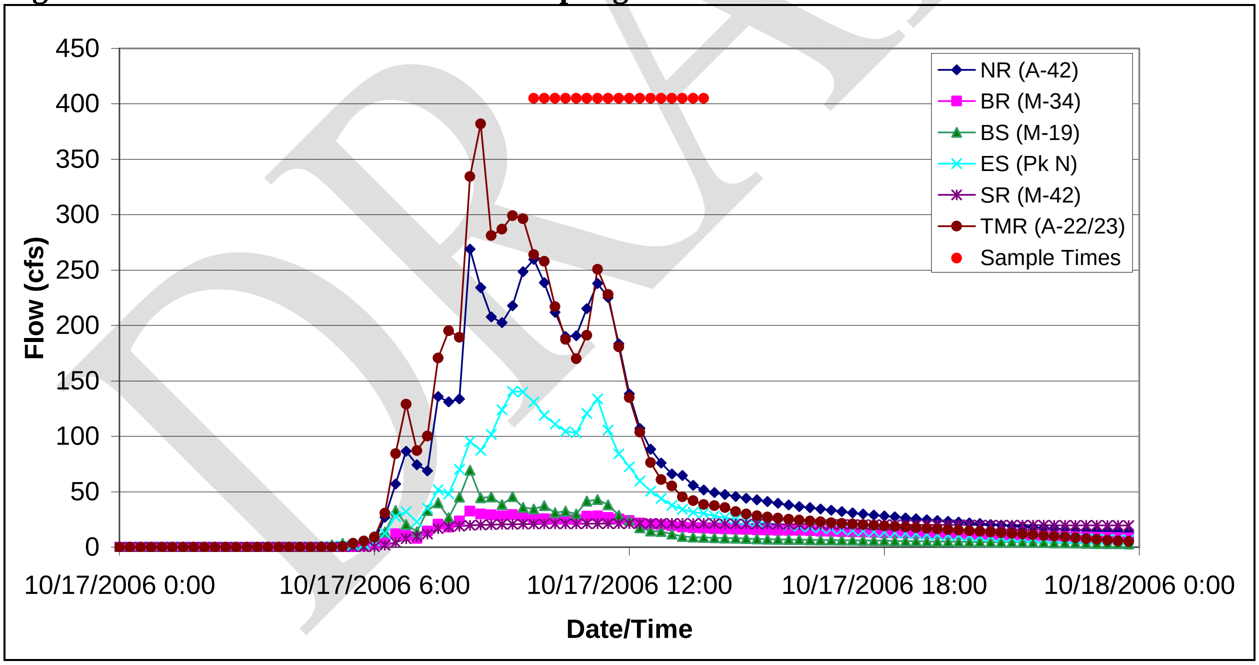


Figure 3-12: Flow vs. Time at Each Sampling Location – Event 2



The flows estimated by the model were then used to develop EMCs for each sampling period. The predicted flow was multiplied by the corresponding measured constituent concentration, producing a flow-weighted average concentration for the sampling period. Since measurements were not taken for the entire storm event, the number represents an EMC for the sampling period only, and not the entire storm event. Table 3-6 summarizes the EMCs for each constituent, location, and sampling period.

Table 3-6: Event Mean Concentrations for Sampling Periods

			FC (colonies / 100 mL)			
	NR	**BR**	**BS**	**ES**	**SR**	**TMR**
Event 1	2.7E+06	6.3E+06	1.3E+06	1.9E+06	1.3E+07	2.5E+06
Event 2	5.9E+04	7.2E+05	6.1E+05	6.1E+04	2.9E+06	1.6E+06
Both	4.9E+05	1.9E+06	8.0E+05	2.7E+05	6.3E+06	1.7E+06
			TSS (mg/l)			
	NR	**BR**	**BS**	**ES**	**SR**	**TMR**
Event 1	97	120	117	39	124	159
Event 2	36	52	62	66	63	39
Both	46	67	77	62	84	60
			cBOD5 (mg/l)			
	NR	**BR**	**BS**	**ES**	**SR**	**TMR**
Event 1	32	55	52	7	74	61
Event 2	7	9	13	4	10	7
Both	11	19	23	5	32	17

As indicated by the box plots in the previous section, concentrations during the second event were significantly lower than for the first event. This is likely due to the large amount of stormwater present during the second event. The fact that samples during the second event were taken after the peak of the overflow event may also have contributed to the lower concentrations.

Another measure of the pollutant contributions of a CSO is to calculate its pollutant loading, in mass per event, to its receiving stream. These calculations were done for each of the six sites for each event. The predicted CSO flow rates for each of the locations were multiplied by the measured concentration, resulting in loadings (kg/event). Table 3-7 summarizes the loads for each constituent, location, and event. As the results show, the pollutant loading for the second event is very similar, and in some cases larger, than the pollutant loading for the first event.

Table 3-7: Total Loads for Sampling Period

	NR	BR	BS	ES	SR	TMR
Fecal (colonies)						
Event 1	3.1E+14	1.7E+14	5.2E+13	8.5E+13	6.2E+14	3.4E+14
Event 2	3.5E+13	7.3E+13	6.7E+13	2.1E+13	2.7E+14	1.0E+15
Both	1.7E+14	1.2E+14	5.9E+13	5.3E+13	4.4E+14	6.7E+14
TSS (kg)						
	NR	BR	BS	ES	SR	TMR
Event 1	1132	328	454	175	601	2139
Event 2	2135	525	679	2294	579	2472
Both	1634	427	567	1235	590	2305
cBOD5 (kg)						
	NR	BR	BS	ES	SR	TMR
Event 1	373	150	200	34	357	820
Event 2	442	88	142	154	93	479
Both	408	119	171	94	225	649

3.4 DATA ANALYSIS CONCLUSIONS

This section presented water quality data obtained from six CSO locations, and the associated data analyses that were performed to characterize CSO pollutant compositions and loadings. Measurements were taken for fecal coliform, TSS, and $cBOD_5$ at six CSO locations.

According to the analyses, land use type did not appear to have an impact on CSO pollutant compositions and loadings. Residential, forest and grassland use types made up the majority of land uses tributary to each location, and there were no significant commercial or industrial areas tributary to any location. Commercial and industrial areas often have higher TSS loadings due to their many impervious areas.

Pollutant concentrations observed for Event 2 tended to be lower than those observed for Event 1. Since Event 2 was larger than Event 1 in terms of rainfall, this difference may be attributable to higher volumes of stormwater entering the systems, thereby diluting the existing sanitary flows. However, sampling for Event 2 started after the peak of the CSO event, and the lower concentrations observed for Event 2 could possibly be due to missing the “first flush” of pollutants. Box plots of pollutant concentrations versus time during Event 1 indicate the possibility of a “first flush” effect for TSS and $cBOD_5$, with higher concentrations being seen in the first two to three hours of sampling. Graphs of predicted overflow rate versus time during Event 1 indicate that peak flow rates were not reached until one to two hours into the sampling period. It is possible that these high flow rates began to dilute the pollutants, thus reducing their concentrations over the final hours of the sampling period.

Pollutant EMCs (mg/L) and loads (kg/event) were calculated using estimated CSO flows from the current PWSA InfoWorks CS hydraulic and hydrologic computer model. However, since the model does not account for the influence of the interceptor, assumptions had to be made concerning the boundary condition at each regulator. These assumptions will affect the precision of these results.

Caution should be used when interpreting this data, since only two events were sampled and analyzed for this report. To identify and confirm trends in data variation, additional sampling efforts would be required.

Appendix A – Field Data Collection Sheets

Beck's Run

Event #1 – Date:________________

Sample	TSS	FC
Equipment Blank @ t=______	BR-01-TSS/BOD-EB	BR-01-FC-EB
Field Dup @ t=______	BR-01-TSS/BOD-FD	BR-01-FC-FD
t=0 Time:_____________	BR-01-TSS/BOD-000	BR-01-FC-000
t=15min	BR-01-TSS/BOD-015	BR-01-FC-015
t=30min	BR-01-TSS/BOD-030	BR-01-FC-030
t=45min	BR-01-TSS/BOD-045	BR-01-FC-045
t=1hr	BR-01-TSS/BOD-060	BR-01-FC-060
t=1hr 15min	BR-01-TSS/BOD-075	BR-01-FC-075
t=1hr 30min	BR-01-TSS/BOD-090	BR-01-FC-090
t=1hr 45min	BR-01-TSS/BOD-105	BR-01-FC-105
t=2hr	BR-01-TSS/BOD-120	BR-01-FC-120
t=2hr 15min	BR-01-TSS/BOD-135	BR-01-FC-135
t=2 hr 30min	BR-01-TSS/BOD-150	BR-01-FC-150
t=2hr 45min	BR-01-TSS/BOD-165	BR-01-FC-165
t=3hr	BR-01-TSS/BOD-180	BR-01-FC-180
t=3hr 15min	BR-01-TSS/BOD-195	BR-01-FC-195
t=3 hr 30min	BR-01-TSS/BOD-210	BR-01-FC-210
t=3hr 45min	BR-01-TSS/BOD-225	BR-01-FC-225
t=4hr	BR-01-TSS/BOD-240	BR-01-FC-240
Totals:	19	19

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Beck's Run

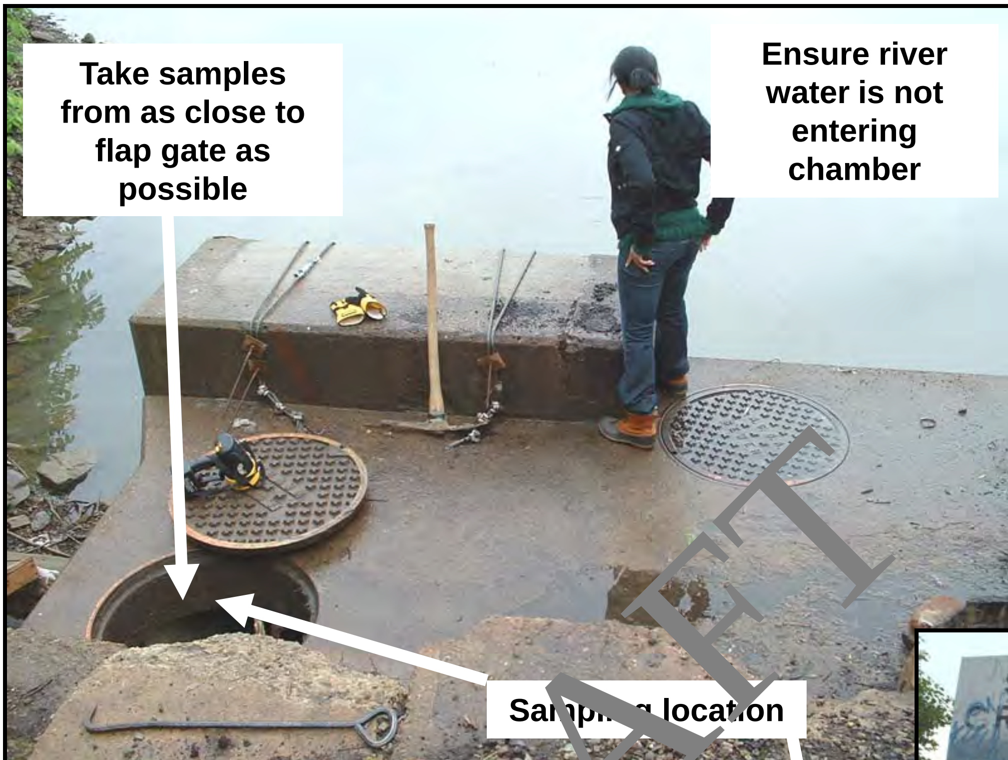
Event #2 – Date:________________

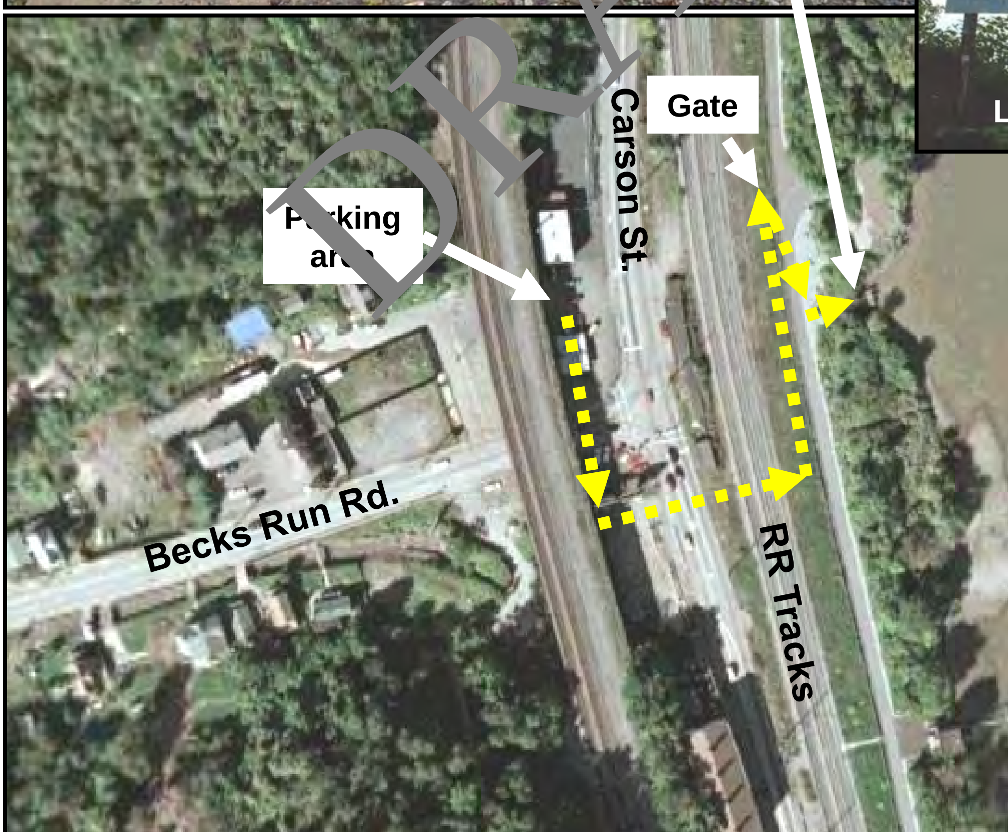
Sample	**TSS**	**FC**
Equipment Blank @ t=______	BR-02-TSS/BOD-EB	BR-02-FC-EB
Field Dup @ t=______	N/A	N/A
t=0 Time:_____________	BR-02-TSS/BOD-000	BR-02-FC-000
t=15min	BR-02-TSS/BOD-015	BR-02-FC-015
t=30min	BR-02-TSS/BOD-030	BR-02-FC-030
t=45min	BR-02-TSS/BOD-045	BR-02-FC-045
t=1hr	BR-02-TSS/BOD-060	BR-02-FC-060
t=1hr 15min	BR-02-TSS/BOD-075	BR-02-FC-075
t=1hr 30min	BR-02-TSS/BOD-090	BR-02-FC-090
t=1hr 45min	BR-02-TSS/BOD-105	BR-02-FC-105
t=2hr	BR-02-TSS/BOD-120	BR-02-FC-120
t=2hr 15min	BR-02-TSS/BOD-135	BR-02-FC-135
t=2 hr 30min	BR-02-TSS/BOD-150	BR-02-FC-150
t=2hr 45min	BR-02-TSS/BOD-165	BR-02-FC-165
t=3hr	BR-02-TSS/BOD-180	BR-02-FC-180
t=3hr 15min	BR-02-TSS/BOD-195	BR-02-FC-195
t=3 hr 30min	BR-02-TSS/BOD-210	BR-02-FC-210
t=3hr 45min	BR-02-TSS/BOD-225	BR-02-FC-225
t=4hr	BR-02-TSS/BOD-240	BR-02-FC-240
Totals:	18	18

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Beck's Run
Site Sheet





Street's Run

Event #1 – Date:_________________

Sample	TSS	FC
Equipment Blank @ t=______	SR-01-TSS/BOD-EB	SR-01-FC-EB
Field Dup @ t=______	N/A	N/A
t=0 Time:_____________	SR-01-TSS/BOD-000	SR-01-FC-000
t=15min	SR-01-TSS/BOD-015	SR-01-FC-015
t=30min	SR-01-TSS/BOD-030	SR-01-FC-030
t=45min	SR-01-TSS/BOD-045	SR-01-FC-045
t=1hr	SR-01-TSS/BOD-060	SR-01-FC-060
t=1hr 15min	SR-01-TSS/BOD-075	SR-01-FC-075
t=1hr 30min	SR-01-TSS/BOD-090	SR-01-FC-090
t=1hr 45min	SR-01-TSS/BOD-105	SR-01-FC-105
t=2hr	SR-01-TSS/BOD-120	SR-01-FC-120
t=2hr 15min	SR-01-TSS/BOD-135	SR-01-FC-135
t=2 hr 30min	SR-01-TSS/BOD-150	SR-01-FC-150
t=2hr 45min	SR-01-TSS/BOD-165	SR-01-FC-165
t=3hr	SR-01-TSS/BOD-180	SR-01-FC-180
t=3hr 15min	SR-01-TSS/BOD-195	SR-01-FC-195
t=3 hr 30min	SR-01-TSS/BOD-210	SR-01-FC-210
t=3hr 45min	SR-01-TSS/BOD-225	SR-01-FC-225
t=4hr	SR-01-TSS/BOD-240	SR-01-FC-240
Totals:	18	18

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Street's Run

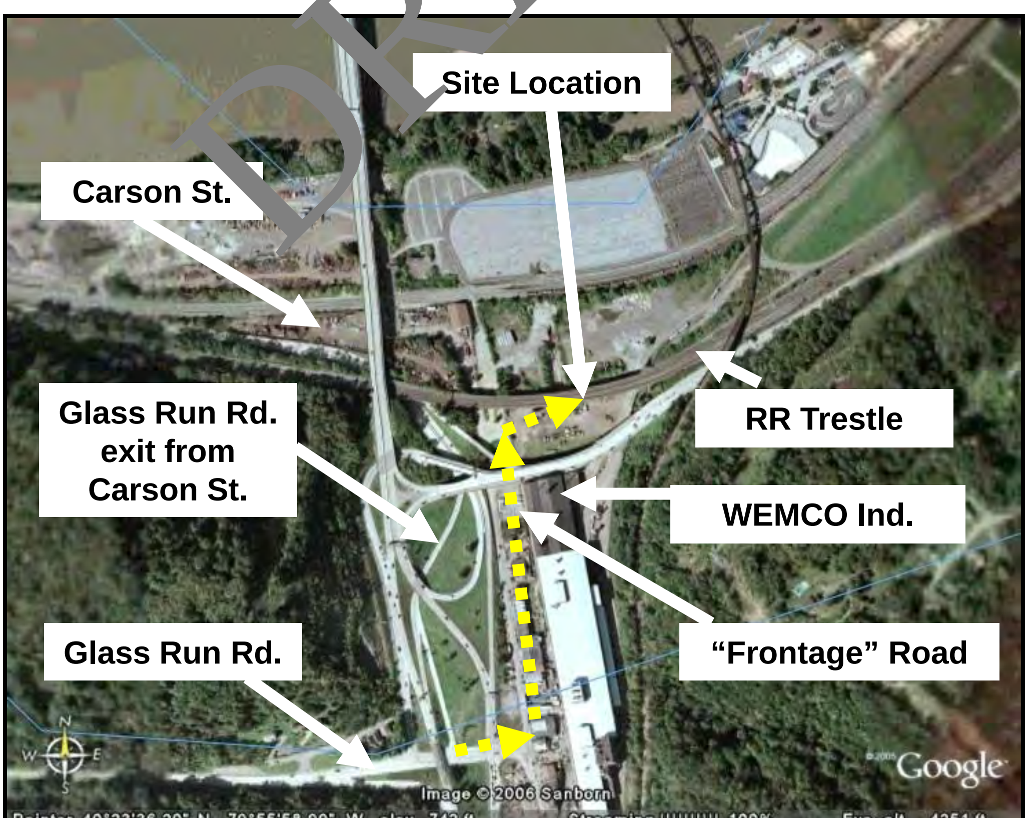
Event #2 – Date:________________

Sample	**TSS**	**FC**
Equipment Blank @ t=______	SR-02-TSS/BOD-EB	SR-02-FC-EB
Field Dup @ t=______	N/A	N/A
t=0 Time:_____________	SR-02-TSS/BOD-000	SR-02-FC-000
t=15min	SR-02-TSS/BOD-015	SR-02-FC-015
t=30min	SR-02-TSS/BOD-030	SR-02-FC-030
t=45min	SR-02-TSS/BOD-045	SR-02-FC-045
t=1hr	SR-02-TSS/BOD-060	SR-02-FC-060
t=1hr 15min	SR-02-TSS/BOD-075	SR-02-FC-075
t=1hr 30min	SR-02-TSS/BOD-090	SR-02-FC-090
t=1hr 45min	SR-02-TSS/BOD-105	SR-02-FC-105
t=2hr	SR-02-TSS/BOD-120	SR-02-FC-120
t=2hr 15min	SR-02-TSS/BOD-135	SR-02-FC-135
t=2 hr 30min	SR-02-TSS/BOD-150	SR-02-FC-150
t=2hr 45min	SR-02-TSS/BOD-165	SR-02-FC-165
t=3hr	SR-02-TSS/BOD-180	SR-02-FC-180
t=3hr 15min	SR-02-TSS/BOD-195	SR-02-FC-195
t=3 hr 30min	SR-02-TSS/BOD-210	SR-02-FC-210
t=3hr 45min	SR-02-TSS/BOD-225	SR-02-FC-225
t=4hr	SR-02-TSS/BOD-240	SR-02-FC-240
Totals:	18	18

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Street's Run
Site Sheet



Bates Street (M-19)

Event #1 – Date:________________

Sample	TSS	FC
Equipment Blank @ t=______	BS-01-TSS/BOD-EB	BS-01-FC-EB
Field Dup @ t=______	N/A	N/A
t=0 Time:_____________	BS-01-TSS/BOD-000	BS-01-FC-000
t=15min	BS-01-TSS/BOD-015	BS-01-FC-015
t=30min	BS-01-TSS/BOD-030	BS-01-FC-030
t=45min	BS-01-TSS/BOD-045	BS-01-FC-045
t=1hr	BS-01-TSS/BOD-060	BS-01-FC-060
t=1hr 15min	BS-01-TSS/BOD-075	BS-01-FC-075
t=1hr 30min	BS-01-TSS/BOD-090	BS-01-FC-090
t=1hr 45min	BS-01-TSS/BOD-105	BS-01-FC-105
t=2hr	BS-01-TSS/BOD-120	BS-01-FC-120
t=2hr 15min	BS-01-TSS/BOD-135	BS-01-FC-135
t=2 hr 30min	BS-01-TSS/BOD-150	BS-01-FC-150
t=2hr 45min	BS-01-TSS/BOD-165	BS-01-FC-165
t=3hr	BS-01-TSS/BOD-180	BS-01-FC-180
t=3hr 15min	BS-01-TSS/BOD-195	BS-01-FC-195
t=3 hr 30min	BS-01-TSS/BOD-210	BS-01-FC-210
t=3hr 45min	BS-01-TSS/BOD-225	BS-01-FC-225
t=4hr	BS-01-TSS/BOD-240	BS-01-FC-240
Totals:	18	18

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Bates Street (M-19)

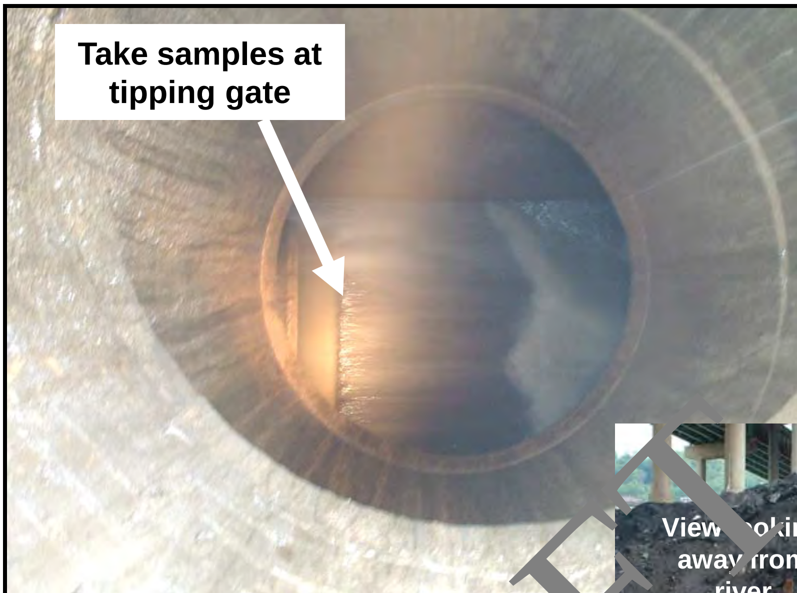
Event #2 – Date:________________

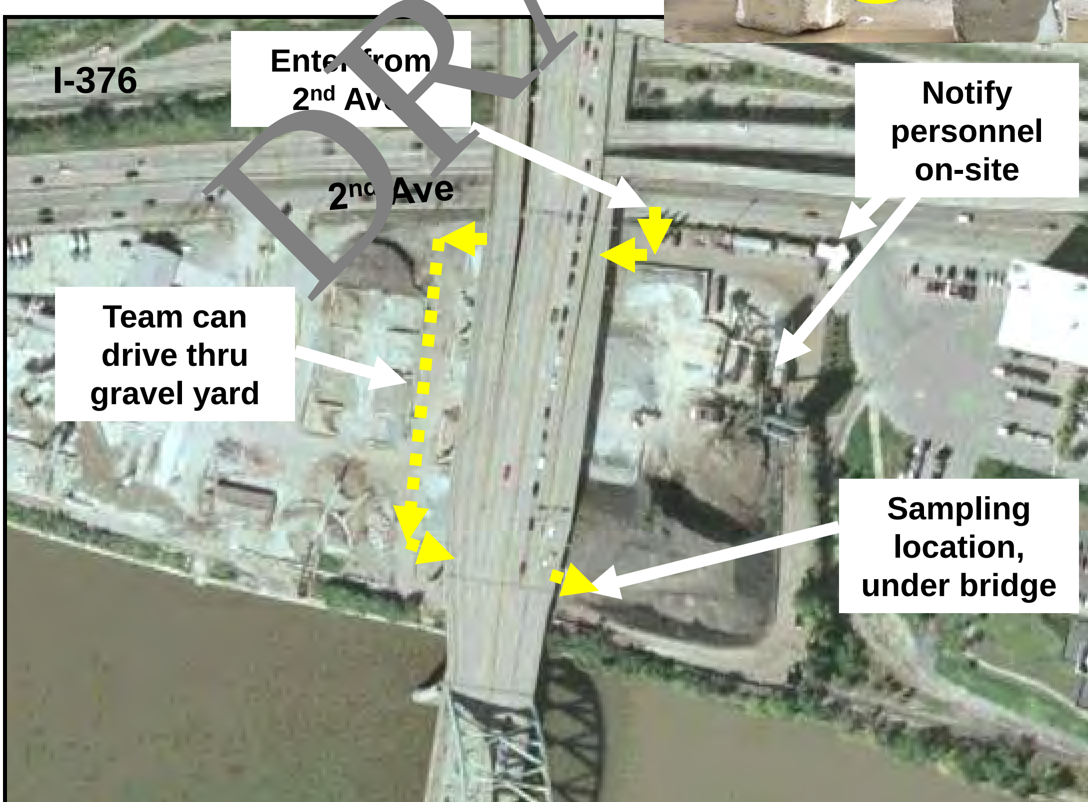
Sample	**TSS**	**FC**
Equipment Blank @ t=______	BS-02-TSS/BOD-EB	BS-02-FC-EB
Field Dup @ t=______	BS-02-TSS/BOD-FD	BS-02-FC-FD
t=0 Time:______________	BS-02-TSS/BOD-000	BS-02-FC-000
t=15min	BS-02-TSS/BOD-015	BS-02-FC-015
t=30min	BS-02-TSS/BOD-030	BS-02-FC-030
t=45min	BS-02-TSS/BOD-045	BS-02-FC-045
t=1hr	BS-02-TSS/BOD-060	BS-02-FC-060
t=1hr 15min	BS-02-TSS/BOD-075	BS-02-FC-075
t=1hr 30min	BS-02-TSS/BOD-090	BS-02-FC-090
t=1hr 45min	BS-02-TSS/BOD-105	BS-02-FC-105
t=2hr	BS-02-TSS/BOD-120	BS-02-FC-120
t=2hr 15min	BS-02-TSS/BOD-135	BS-02-FC-135
t=2 hr 30min	BS-02-TSS/BOD-150	BS-02-FC-150
t=2hr 45min	BS-02-TSS/BOD-165	BS-02-FC-165
t=3hr	BS-02-TSS/BOD-180	BS-02-FC-180
t=3hr 15min	BS-02-TSS/BOD-195	BS-02-FC-195
t=3 hr 30min	BS-02-TSS/BOD-210	BS-02-FC-210
t=3hr 45min	BS-02-TSS/BOD-225	BS-02-FC-225
t=4hr	BS-02-TSS/BOD-240	BS-02-FC-240
Totals:	19	19

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Bates Street (M-19)
Site Sheet





East Street

Event #1 – Date:________________

Sample	TSS	FC
Equipment Blank @ t=______	ES-01-TSS/BOD-EB	ES-01-FC-EB
Field Dup @ t=______	N/A	N/A
t=0 Time:_____________	ES-01-TSS/BOD-000	ES-01-FC-000
t=15min	ES-01-TSS/BOD-015	ES-01-FC-015
t=30min	ES-01-TSS/BOD-030	ES-01-FC-030
t=45min	ES-01-TSS/BOD-045	ES-01-FC-045
t=1hr	ES-01-TSS/BOD-060	ES-01-FC-060
t=1hr 15min	ES-01-TSS/BOD-075	ES-01-FC-075
t=1hr 30min	ES-01-TSS/BOD-090	ES-01-FC-090
t=1hr 45min	ES-01-TSS/BOD-105	ES-01-FC-105
t=2hr	ES-01-TSS/BOD-120	ES-01-FC-120
t=2hr 15min	ES-01-TSS/BOD-135	ES-01-FC-135
t=2 hr 30min	ES-01-TSS/BOD-150	ES-01-FC-150
t=2hr 45min	ES-01-TSS/BOD-165	ES-01-FC-165
t=3hr	ES-01-TSS/BOD-180	ES-01-FC-180
t=3hr 15min	ES-01-TSS/BOD-195	ES-01-FC-195
t=3 hr 30min	ES-01-TSS/BOD-210	ES-01-FC-210
t=3hr 45min	ES-01-TSS/BOD-225	ES-01-FC-225
t=4hr	ES-01-TSS/BOD-240	ES-01-FC-240
Totals:	18	18

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

East Street

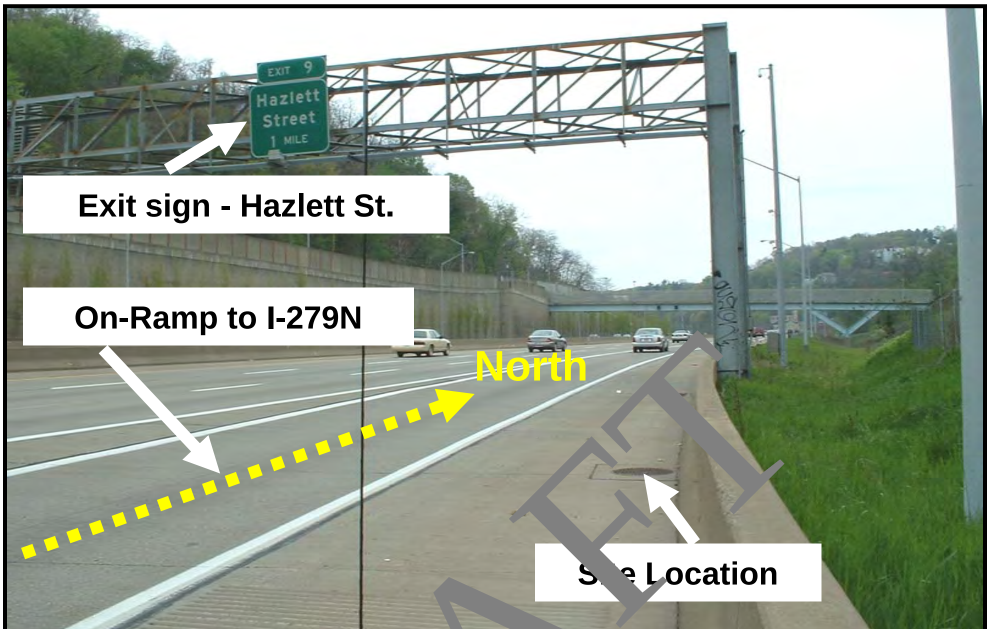
Event #2 – Date:________________

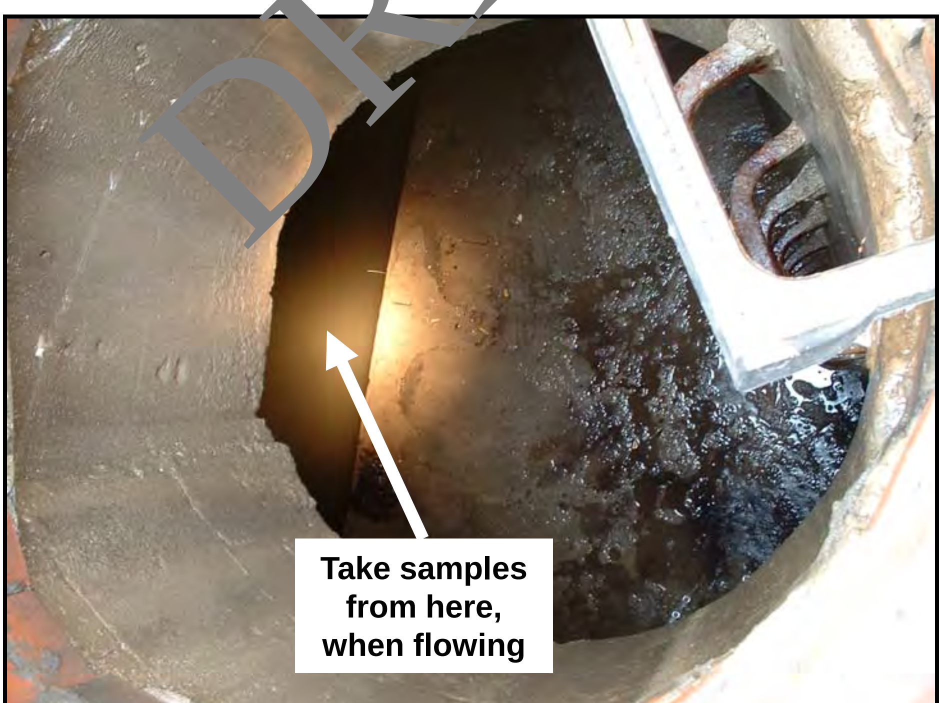
Sample	TSS	FC
Equipment Blank @ t=______	ES-02-TSS/BOD-EB	ES-02-FC-EB
Field Dup @ t=______	ES-02-TSS/BOD-FD	ES-02-FC-FD
t=0 Time:______________	ES-02-TSS/BOD-000	ES-02-FC-000
t=15min	ES-02-TSS/BOD-015	ES-02-FC-015
t=30min	ES-02-TSS/BOD-030	ES-02-FC-030
t=45min	ES-02-TSS/BOD-045	ES-02-FC-045
t=1hr	ES-02-TSS/BOD-060	ES-02-FC-060
t=1hr 15min	ES-02-TSS/BOD-075	ES-02-FC-075
t=1hr 30min	ES-02-TSS/BOD-090	ES-02-FC-090
t=1hr 45min	ES-02-TSS/BOD-105	ES-02-FC-105
t=2hr	ES-02-TSS/BOD-120	ES-02-FC-120
t=2hr 15min	ES-02-TSS/BOD-135	ES-02-FC-135
t=2 hr 30min	ES-02-TSS/BOD-150	ES-02-FC-150
t=2hr 45min	ES-02-TSS/BOD-165	ES-02-FC-165
t=3hr	ES-02-TSS/BOD-180	ES-02-FC-180
t=3hr 15min	ES-02-TSS/BOD-195	ES-02-FC-195
t=3 hr 30min	ES-02-TSS/BOD-210	ES-02-FC-210
t=3hr 45min	ES-02-TSS/BOD-225	ES-02-FC-225
t=4hr	ES-02-TSS/BOD-240	ES-02-FC-240
Totals:	19	19

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

East Street
Site Sheet





Negley Run (A-42)

Event #1 – Date:________________

Sample	TSS	FC
Equipment Blank @ t=______	NR-01-TSS/BOD-EB	NR-01-FC-EB
Field Dup @ t=______	NR-01-TSS/BOD-FD	NR-01-FC-FD
t=0 Time:_____________	NR-01-TSS/BOD-000	NR-01-FC-000
t=15min	NR-01-TSS/BOD-015	NR-01-FC-015
t=30min	NR-01-TSS/BOD-030	NR-01-FC-030
t=45min	NR-01-TSS/BOD-045	NR-01-FC-045
t=1hr	NR-01-TSS/BOD-060	NR-01-FC-060
t=1hr 15min	NR-01-TSS/BOD-075	NR-01-FC-075
t=1hr 30min	NR-01-TSS/BOD-090	NR-01-FC-090
t=1hr 45min	NR-01-TSS/BOD-105	NR-01-FC-105
t=2hr	NR-01-TSS/BOD-120	NR-01-FC-120
t=2hr 15min	NR-01-TSS/BOD-135	NR-01-FC-135
t=2 hr 30min	NR-01-TSS/BOD-150	NR-01-FC-150
t=2hr 45min	NR-01-TSS/BOD-165	NR-01-FC-165
t=3hr	NR-01-TSS/BOD-180	NR-01-FC-180
t=3hr 15min	NR-01-TSS/BOD-195	NR-01-FC-195
t=3 hr 30min	NR-01-TSS/BOD-210	NR-01-FC-210
t=3hr 45min	NR-01-TSS/BOD-225	NR-01-FC-225
t=4hr	NR-01-TSS/BOD-240	NR-01-FC-240
Totals:	19	19

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Negley Run (A-42)

Event #2 – Date:_______________

Sample	TSS	FC
Equipment Blank @ t=______	NR-02-TSS/BOD-EB	NR-02-FC-EB
Field Dup @ t=______	N/A	N/A
t=0 Time:_____________	NR-02-TSS/BOD-000	NR-02-FC-000
t=15min	NR-02-TSS/BOD-015	NR-02-FC-015
t=30min	NR-02-TSS/BOD-030	NR-02-FC-030
t=45min	NR-02-TSS/BOD-045	NR-02-FC-045
t=1hr	NR-02-TSS/BOD-060	NR-02-FC-060
t=1hr 15min	NR-02-TSS/BOD-075	NR-02-FC-075
t=1hr 30min	NR-02-TSS/BOD-090	NR-02-FC-090
t=1hr 45min	NR-02-TSS/BOD-105	NR-02-FC-105
t=2hr	NR-02-TSS/BOD-120	NR-02-FC-120
t=2hr 15min	NR-02-TSS/BOD-135	NR-02-FC-135
t=2 hr 30min	NR-02-TSS/BOD-150	NR-02-FC-150
t=2hr 45min	NR-02-TSS/BOD-165	NR-02-FC-165
t=3hr	NR-02-TSS/BOD-180	NR-02-FC-180
t=3hr 15min	NR-02-TSS/BOD-195	NR-02-FC-195
t=3 hr 30min	NR-02-TSS/BOD-210	NR-02-FC-210
t=3hr 45min	NR-02-TSS/BOD-225	NR-02-FC-225
t=4hr	NR-02-TSS/BOD-240	NR-02-FC-240
Totals:	18	18

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Negley Run (A-42)

Site Sheet

Two Mile Run (A-22)

Event #1 – Date:________________

Sample	**TSS**	**FC**
Equipment Blank @ t=______	TMR-01-TSS/BOD-EB	TMR-01-FC-EB
Field Dup @ t=______	N/A	N/A
t=0 Time:_____________	TMR-01-TSS/BOD-000	TMR-01-FC-000
t=15min	TMR-01-TSS/BOD-015	TMR-01-FC-015
t=30min	TMR-01-TSS/BOD-030	TMR-01-FC-030
t=45min	TMR-01-TSS/BOD-045	TMR-01-FC-045
t=1hr	TMR-01-TSS/BOD-060	TMR-01-FC-060
t=1hr 15min	TMR-01-TSS/BOD-075	TMR-01-FC-075
t=1hr 30min	TMR-01-TSS/BOD-090	TMR-01-FC-090
t=1hr 45min	TMR-01-TSS/BOD-105	TMR-01-FC-105
t=2hr	TMR-01-TSS/BOD-120	TMR-01-FC-120
t=2hr 15min	TMR-01-TSS/BOD-135	TMR-01-FC-135
t=2 hr 30min	TMR-01-TSS/BOD-150	TMR-01-FC-150
t=2hr 45min	TMR-01-TSS/BOD-165	TMR-01-FC-165
t=3hr	TMR-01-TSS/BOD-180	TMR-01-FC-180
t=3hr 15min	TMR-01-TSS/BOD-195	TMR-01-FC-195
t=3 hr 30min	TMR-01-TSS/BOD-210	TMR-01-FC-210
t=3hr 45min	TMR-01-TSS/BOD-225	TMR-01-FC-225
t=4hr	TMR-01-TSS/BOD-240	TMR-01-FC-240
Totals:	18	18

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Two Mile Run (A-22)

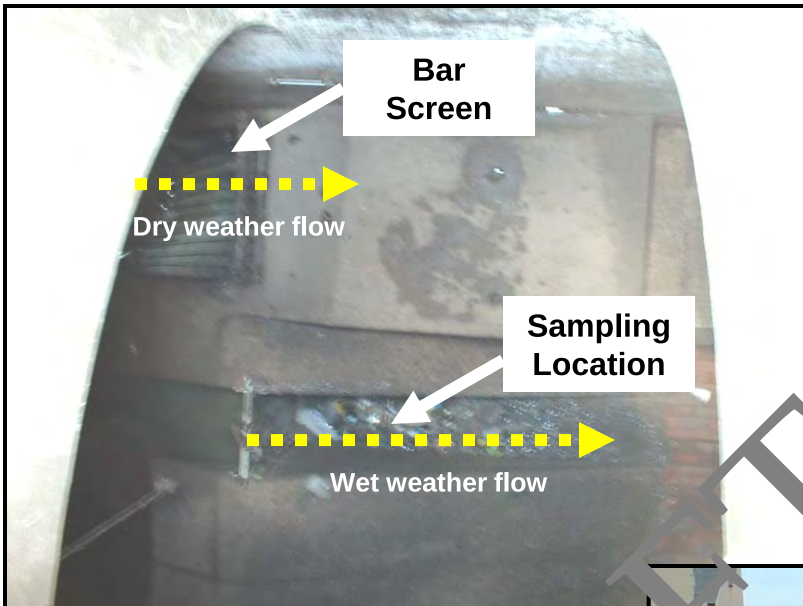
Event #2 – Date:_________________

Sample	TSS	FC
Equipment Blank @ t=______	TMR-02-TSS/BOD-EB	TMR-02-FC-EB
Field Dup @ t=______	N/A	N/A
t=0 Time:_____________	TMR-02-TSS/BOD-000	TMR-02-FC-000
t=15min	TMR-02-TSS/BOD-015	TMR-02-FC-015
t=30min	TMR-02-TSS/BOD-030	TMR-02-FC-030
t=45min	TMR-02-TSS/BOD-045	TMR-02-FC-045
t=1hr	TMR-02-TSS/BOD-060	TMR-02-FC-060
t=1hr 15min	TMR-02-TSS/BOD-075	TMR-02-FC-075
t=1hr 30min	TMR-02-TSS/BOD-090	TMR-02-FC-090
t=1hr 45min	TMR-02-TSS/BOD-105	TMR-02-FC-105
t=2hr	TMR-02-TSS/BOD-120	TMR-02-FC-120
t=2hr 15min	TMR-02-TSS/BOD-135	TMR-02-FC-135
t=2 hr 30min	TMR-02-TSS/BOD-150	TMR-02-FC-150
t=2hr 45min	TMR-02-TSS/BOD-165	TMR-02-FC-165
t=3hr	TMR-02-TSS/BOD-180	TMR-02-FC-180
t=3hr 15min	TMR-02-TSS/BOD-195	TMR-02-FC-195
t=3 hr 30min	TMR-02-TSS/BOD-210	TMR-02-FC-210
t=3hr 45min	TMR-02-TSS/BOD-225	TMR-02-FC-225
t=4hr	TMR-02-TSS/BOD-240	TMR-02-FC-240
Totals:	18	18

Equipment blanks will be taken for TSS, $cBOD_5$ and FC at each location during each event

Field duplicates will be taken for TSS, $cBOD_5$ and FC at two locations during each event

Two Mile Run (A-22)
Site Sheet



Appendix B – Chain of Custody Form

Figure 1 - Chain of Custody Sheet

Internal Use Only Workorder #

Microbac Laboratories, Inc. - Pittsburgh Division
100 Marshall Drive, Warrendale, PA. 15086 Phone (724)772-0610 Fax (724) 772-1686

Chain of Custody

Sampling Site/Project: ______________________________

Customer Reporting Information		Special Instructions:	
Company: Metcalf & Eddy	PO# ______________		
Contact Name: Keith Jensen	Fax Report Yes No		
Street: 4 Gateway Center, 19th Floor	E-mail Report Yes No		
City: Pittsburgh	Routine TAT: Yes No		If Billing information is different than Reporting Information Please indicate below
State/Zip: PA 15222	If no, Specify days below		Contact Person:________________________
Phone: 412-316-3616 / 412-303-0364	*Rush TAT Requested(Days) ***Rush TAT must be approved by the lab.**		Phone #:____________________________
E-mail: Keith.jensen@m-e.aecom.com	<2 2-5 5-7		

SAMPLE MATRIX CODES					
WATER		**SOLIDS**		**MISC.**	
Drinking Water	DW	Soil	SO	Oil	OL
Ground Water	GW	Sludge	SL	Wipes	WP
Surface Water	SW	Waste		Swabs	SB
Waste Water	WW	Liquid	L	Food	FD
Trip Blank	TB	Solids	S	Micro-biology	MC
Field Blank	FB				

Internal Use WO Sample #	**SAMPLE Matrix** USE CODES ABOVE, if your matrix is not listed specify your matrix below	SAMPLE IDENTIFIC ON	MPLE COL ED TE	E	CO OSITE		OF ONTAINERS	Preservative H	O3	N OH	O4	Na2S2	NONE	Check			Analysis Requested

Relinquished By:(Signature)		Date	Time	Received By:(Signature)		Date	Time
Relinquished By:(Signature)		Date	Time	Received By:(Signature)		Date	Time
Relinquished By:(Signature)		Date	Time	Received By:(Signature)		Date	Time

Sampled By:______________________ Chlorine Reading:_________________	INTERNAL USE Condition:	Field Sampling Notes:
Please deliver samples to the lab as soon as possible after collection to ensure that holding times will be met. Please fill COC out completely to expedite sample Log-in.	Avg.Sample Temp: °C	

Appendix C - Table of Contents for Health and Safety Plan (HASP)

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PART I: GENERAL HEALTH & SAFETY GUIDELINES

PART II: CONFINED SPACE ENTRY PROCEDURES

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PART III: TRAFFIC CONTROL

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LIST OF APPENDICES

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LIST OF ABBREVIATIONS AND ACRONYMS

ACGIH	-	American Conference of Governmental Industrial Hygienists
APR	-	Air Purifying Respirator
AWT	-	Air & Water Technologies Corporation
CCTV	-	Closed-Circuit Television
CFR	-	Code of Federal Regulations
CGI	-	Combustible Gas Indicator
CPR	-	Cardiopulmonary Resuscitation
CSEP	-	Confined Space Entry Permit
HASP	-	Health and Safety Plan
HNU	-	HNu Photoionization Detector Instrument
IDLH	-	Immediately Dangerous to Life & Health
I/I	-	Inflow and Infiltration
LEL	-	Lower Explosive Limit
LFL	-	Lower Flammable Limit
M&E	-	Metcalf & Eddy of Ohio, Inc.
MSDS	-	Material Safety Data Sheet
MSHA	-	Mine Safety Health Administration
NIOSH	-	National Institute for Occupational Safety & Health
OSHA	-	Occupational Safety And Health Administration
OVA	-	Foxboro Organic Vapor Analyzer
PEL	-	Permissible Exposure Limit per OSHA Law
PPE	-	Personal Protective Equipment
PPM	-	Parts Per Million
PWSA		Pittsburgh Water and Sewer Authority
SAR	-	Supplied-Air Respirators
SHSO	-	Site Health and Safety Officer
TLV	-	Threshold Limit Value (ACGIH Recommendation)
TWA	-	Time Weighted Average

Baker

December 19, 2006

Pittsburgh Water & Sewer Authority
441 Smithfield Street
Pittsburgh, PA 15222

Attention: Michael D. Lichte, P.E.
Director Engineering & Construction

Re: Receiving Water Quality Assessment Program Technical Memorandum
Development of a LTCP for Combined Sewer Overflow Abatement
Task G - Water Quality Assessment Program

Dear Mr. Lichte:

Three copies of the bound Technical Memorandum for the referenced Receiving Water Quality Assessment Program are transmitted herewith. As you know, this program was undertaken for the tributary creeks (Becks Run, Chartiers Creek, Nine Mile Run, Saw Mill Run, and Streets Run) within PWSA's service area. The need to conduct this program was outlined in the previous Monitoring and Sampling Plan. That Plan outlined a need to understand if there are dissolved oxygen depressions that may result from wet weather discharges from PWSA's system and may affect the choice of CSO control alternatives.

The attached memorandum describes the equipment used, installation methods, QA/QC approach and the final data set collected during the Program. It also contains analysis, findings and recommendations that will help define PWSA's Long-Term Control Plan for Abatement of CSOs. Each binder also contains a CD of the text and figures, along with the complete data set.

If you should have any questions, please do not hesitate to contact us.

Sincerely,

MICHAEL BAKER JR., INC.

John M Shannon

John M. Shannon, P.E.
Project Manager

cc: Andrew Maul - PWSA
Dave Bingham – M&E
Tony Igwe – Wade Trim
Ellen Hanna – Collective Efforts

ATTACHMENT C - APPENDIX B

RECEIVING WATER QUALITY ASSESSMENT PROGRAM TECHNICAL MEMORANDUM

Prepared for

PITTSBURGH WATER AND SEWER AUTHORITY

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service
Engineering & Construction Division

By

Michael Baker Jr. Inc.

Baker

Development of a Long-Term Control Plan for Combined Sewer Overflow Abatement Region 2

PWSA Project Number 01013.02

December 2006

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Receiving Water Quality Assessment Program Technical Memorandum

1.0 INTRODUCTION

This technical memorandum is part of a series of documents that form the basis for the Combined Sewer Overflow (CSO) Long-Term Control Plan (LTCP) Program. The fundamental objective of the CSO LTCP is to control CSO discharges to such a level that the discharges no longer contribute to the non-attainment of receiving water quality standards (WQS). Thus, when evaluating CSO control alternatives in the development of a LTCP, it is appropriate to assess the water quality benefits earned with the implementation of the recommended CSO control plan. Accordingly, PWSA has undertaken a water quality assessment program to understand how discharges from the City of Pittsburgh's CSOs may impact receiving stream water quality. The overall program includes monitoring of receiving water quality and selected CSO outfalls.

This technical memorandum the receiving Water Quality Assessment Program objectives, methodologies, data collection and quality assurance/quality control (QA/QC) procedures, data analysis procedures and findings, and recommendations for the LTCP based on the data.

1.1 PURPOSE OF THE WATER QUALITY PROGRAM

The receiving water characterization program was undertaken first to understand the extent and magnitude of ongoing in-stream water quality issues. Its primary objective is to show areas of dissolved oxygen depletion along the tributary streams that are associated with CSO events. This sampling program will document the water quality issues along the various streams in support of devising the best economically feasible CSO control strategy.

1.2 BACKGROUND

PWSA completed a "Monitoring and Sampling Plan" (M&S Plan) in January 2004. This plan outlined proposed steps for the characterization of existing conditions for the development of PWSA's wet weather program. As part of this plan, an extensive review of the existing water quality for the receiving streams and rivers within the PWSA service area was undertaken. Section 7.0 of the M&S Plan contains a detailed description of data and data sources for the three rivers (Ohio, Allegheny & Monongahela) as well as the tributary streams. This section concluded that adequate data (for PWSA's purposes) had been collected for the three main rivers. However, the quality and applicability of the available data for the tributary streams were questionable.

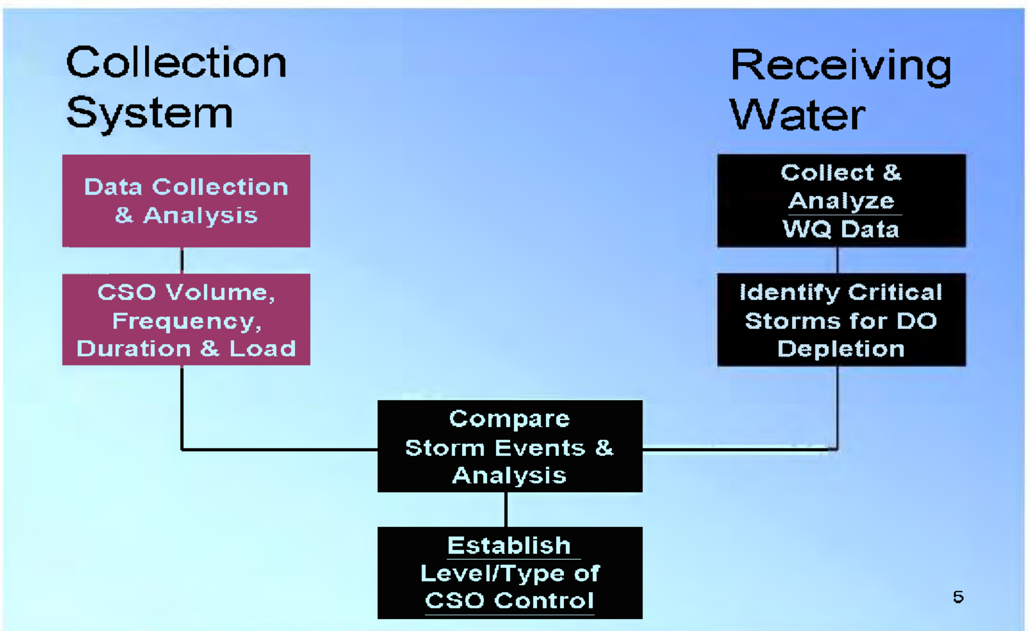
In addition to the available data, the size of the three main rivers, compared to the tributary CSOs showed that any likely water quality impacts would be limited to bacteria & floatables. This has been the experience in other CSO communities that discharge to large rivers. However, none of the available data on the tributary streams addressed potential dissolved oxygen depressions during wet weather events. This gave rise to the need to monitor these streams to document impact of wet weather discharges on dissolved oxygen.

1.3 WATER QUALITY ASSESSMENT APPROACH

This section outlines the overall water quality assessment approach utilized for the PWSA Long Term CSO Control Plan. The approach is shown in the graphics in Figure 1-1.

This figure shows a two pronged approach to CSO control planning. Collection system analysis steps are outlined as well as the receiving water quality analysis steps.

Figure 1-1
Water Quality Assessment Approach



These two prongs are performed simultaneously. Information used to understand the collection system is assembled and used to develop a hydrologic and hydraulic representation of the system. This representation is calibrated and verified through the use of flow monitors. The calibrated model is used to provide estimates of CSO volume, frequency and duration. Pollutant data collected at the end-of-pipe is used in conjunction with the model results to provide estimates of pollutants loading to the receiving stream.

The receiving water quality aspects of the program involve understanding existing water quality issues and ensuring how much of theses issues are attributable to discharges from the collection system during wet weather events. Thorough understanding of the collection system as well as the receiving stream leads to development of alternatives that will help ensure that future discharges from the PWSA system will not contribute to non-attainment of water quality standards, especially dissolved oxygen.

2.0 FIELD PROGRAM OVERVIEW

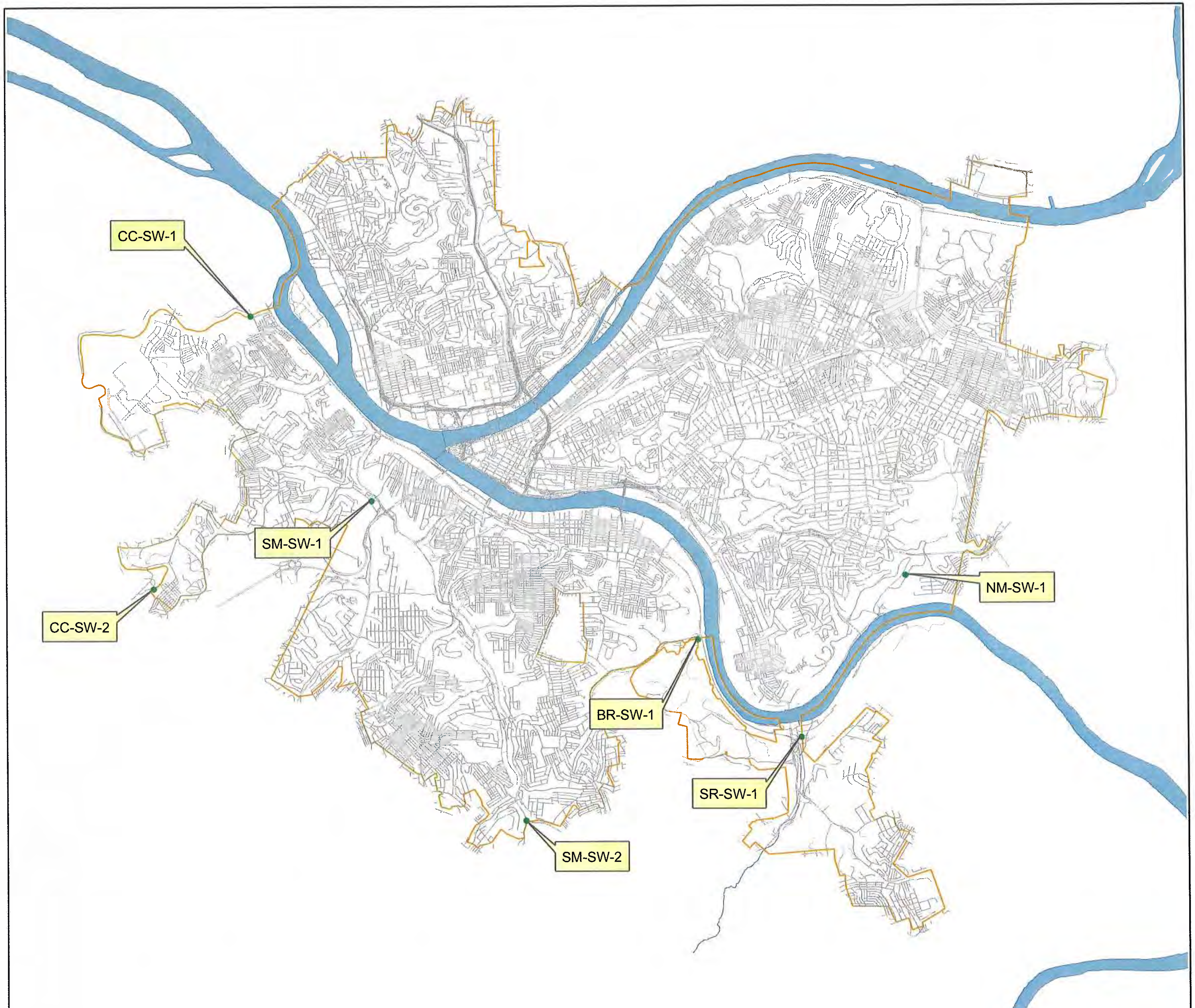
The receiving water characterization field program began on June 1, 2006 and ended October 1, 2006. A two week shake down period was conducted in May to identify and resolve potential problems with equipment installation and use. Seven monitoring locations were selected in, or just outside of, the City of Pittsburgh along the five streams that receive PWSA CSOs and are within the PWSA Service Area. The locations were monitored for parameters that could indicate water quality impacts due to CSOs. The details of the field program are described in the following sections.

2.1 WATER QUALITY MONITORING LOCATIONS

The seven monitoring locations that were selected are shown on Figure 2-1, along the five streams that flow through the City of Pittsburgh limits. Each of the five streams (Becks Run, Chartiers Creek, Nine Mile Run, Saw Mill Run, and Streets Run) have monitoring locations that are downstream of the majority of the CSO outfalls on the streams. Chartiers Creek and Saw Mill Run also have monitoring locations at the upstream boundary of the City of Pittsburgh and adjacent municipalities in order to establish if there are CSO impacts from communities upstream of the City of Pittsburgh. The other streams do not have upstream monitoring locations because the stream is almost entirely within the city limits, or there are no known CSOs discharging to the stream from the upstream communities.

Two methods of monitor installation were used, depending on site conditions. For shallow streams, the ‘in-stream’ installation configuration was used, as shown in Photo A on page 2-3. This includes a pipe length hammered into the streambed with a chain and protective PVC pipe attached and floating free in the streamflow. The PVC pipe has holes in it to allow free flow of water past the probes of the sonde. The sonde is placed inside the protective tube. A cover was placed over the upstream end of the protective pipe to minimize the amount of sediment getting into the pipe and subsequently blocking the probes. Floats were attached to the downstream end of the tube so as stream flow gets higher, the probes stay in the flow and do not get covered by sediment when the stream flow recedes. The other method, called streambank installation, was used for larger, deeper streams with steep banks where the sonde could be placed more vertically in the stream flow, as shown on Photo C on page 2-6.

A description of each of the monitoring locations is provided below. A summary of the locations is provided in Table 2-1. Site location maps are provided in Figures 2-2 through 2-6. Brief descriptions of the sewersheds in which each monitoring site is located are also provided below.



Legend

City of Pittsburgh

Monitoring Location

N
W
E
S

1 0 1 Miles

Figure 2-1
PWSA Water Quality Monitoring Locations Technical Memorandum
December, 2006

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service
Engineering & Construction Division

2.1.1 Becks Run

The Becks Run sewershed (and watershed) is approximately 1,700 acres in size and is located in portions of the City of Pittsburgh, Baldwin Borough, and Mount Oliver Borough. The receiving stream is open for most of its length but appears to have been straightened and its floodplain filled in order to accommodate Becks Run Road. The topography surrounding the stream and floodplain is steep. The land use includes commercial and residential development. Three PWSA CSOs discharge to Becks Run and its tributaries. Becks Run discharges to the Monongahela River. Figure 2-2 shows the monitoring location (BR-SW-1) in the downstream part of the sewershed near the intersection of Becks Run Road and West Carson Street. As shown in Photo A, the monitor was installed with the in-stream configuration at this site.

Photo A: BR-SW-1

Table 2-1
Summary of Water Quality Monitoring Locations

Sewershed	Location Number	Type of Monitor Location	Location Description	Installation Methods	Accessibility
Becks Run	**BR-SW-1** (Becks Run near West Carson St.)	Downstream location	Just upstream of bridge crossing over creek (private driveway); downstream of all PWSA CSOs; approximately 6,000 ft downstream of nearest CSO	In Stream installation	Stream and monitoring location easily accessible via private property
Chartiers Creek	**CC-SW-1** (Chartiers Creek at Stafford St. - right decending bank)	Downstream location	Bridge crossing at the corner of Stanhope and Stafford Rds. near Wendy's Restaurant; within 100 feet of nearest upstream CSO structure on opposite bank and 750 feet of nearest upstream CSO on same bank; downstream of all CSOs except for four.	Streambank installation	Steep slopes adjacent to stream but accessible to field crew; Wendy's parking lot across creek for parking. Within PENNDOT right-of-way of bridge.
	CC-SW-2 (Chartiers Creek at boundary of City of Pittsburgh and Carnegie - right decending bank)	Upstream Location - City of Pittsburgh boundary with Carnegie	Upstream of all PWSA CSOs	In Stream installation	Access from parking lot of industrial facility to get onto other side of fence.
Nine Mile Run	**NM-SW-1** (Nine Mile Run near Forward/Center Ave.)	Downstream location	Downstream of all CSOs except 1; approximately 100 feet downstream of the nearest CSO.	In Stream installation	Accessible from Center Avenue Construction Trailer parking lot or street parking and then follow stream (walking) to location
Saw Mill Run	**SM-SW-1** (Saw Mill Run at Minotte Square Bridge)	Downstream location	Bridge crossing at the corner of Minotte and Woodmere Streets; USGS gage station at same location where gage height and discharge data are collected; approximately 1,000 feet downstream of the nearest CSO.	In Stream installation	Easily accessible for installation and monitoring; short steep slope to creek; easy pull off on side road/parking area for monitoring.
	SM-SW-2 (Saw Mill Run at Fairhaven and Prospect St.)	Upstream Location - City of Pittsburgh boundary	Near bridge crossing at Saw Mill Run Blvd. and Fairhaven St.	In Stream installation	Easily accessible to field crew and monitoring crew; located in road right-of-way across the street from private residences and "Daniels Alinement" business.
Streets Run	**SR-SW-1** (Streets Run at Sandcastle Waterpark)	Downstream location	Daylighted section of stream (approximately 150 feet long) downstream of WHEMCO on Sandcastle Waterpark property; downstream of all PWSA CSOs (within 150 feet of ALCOSAN M-42); sideslopes are steep but climbable; concrete culvert is partially collapsed and soil is unstable; ALCOSAN CSO M-42 is at the upstream end of the daylighted section; channel may be concrete lined.	Streambank installation	Need to coordinate with P.J. Caruso Construction to enter gated property; daylighted portion of stream is surrounded by chainlink fence that is locked; we had permission to put our own lock on the fence until the end of the monitoring period.

Legend

- City of Pittsburgh
- PWSA CSO
- PWSA Permitted ALCOSAN CSO
- Monitoring Location

N
W
E
S

0.25 0 0.25 Miles

Figure 2-2
Becks Run Monitoring Location
Technical Memorandum
December, 2006

PWSA THE PITTSBURGH WATER & SEWER AUTHORITY Quality Water Quality Service
Engineering & Construction Division

2.1.2 Chartiers Creek

The Chartiers Creek watershed is located in portions of Allegheny County and Washington County. The entire watershed is 277 square miles in area and discharges to the Ohio River at the border of McKees Rocks Borough and the City of Pittsburgh. More than 160,000 people live within the watershed boundary and land use incudes residential, commercial, industrial and rural areas. All or a portion of forty municipalities lie within the watershed. There are ten sewage treatment providers and thirty-one CSOs in the watershed. (source: "Watershed Facts" from the Lower Chartiers Creek Watershed Council website; www.lcwc.net). PWSA serves approximately 982 acres of the Chartiers Creek watershed and manages seven CSOs.

Figure 2-3 shows the locations of the two monitoring locations in Chartiers Creek. Monitoring locations CC-SW-1 is near the Stafford Street Bridge near the Ohio River. As shown in Photos B and C, this monitor was installed with the streambank installation configuration. CC-SW-2 is located at the upstream border of the City of Pittsburgh and Carnegie Borough. As shown in Photos D and E, this monitor was installed with the in-stream configuration. There is a USGS gage station at Carnegie approximately 1.6 miles upstream of this location.

Photo B: CC-SW-1

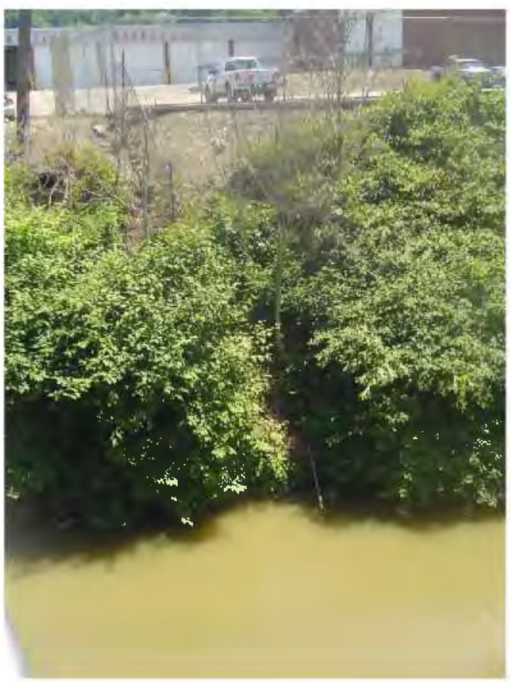


Photo C: CC-SW-1

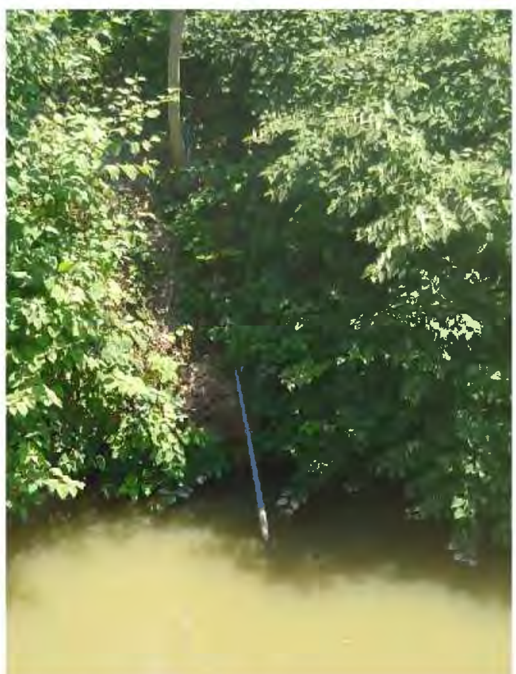


Photo D: CC-SW-2

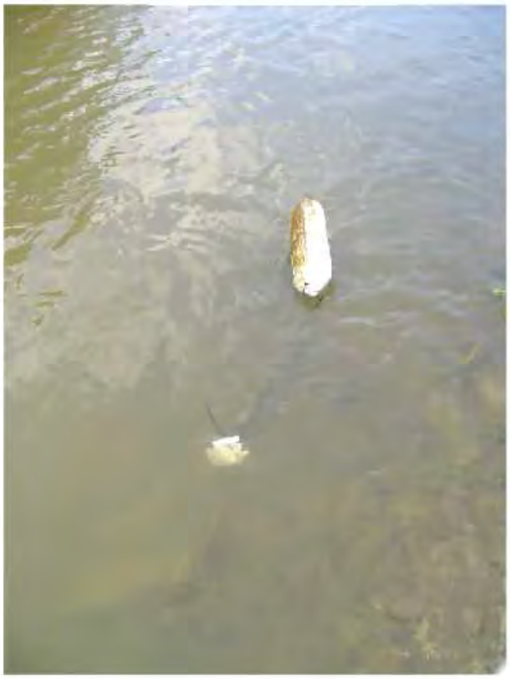
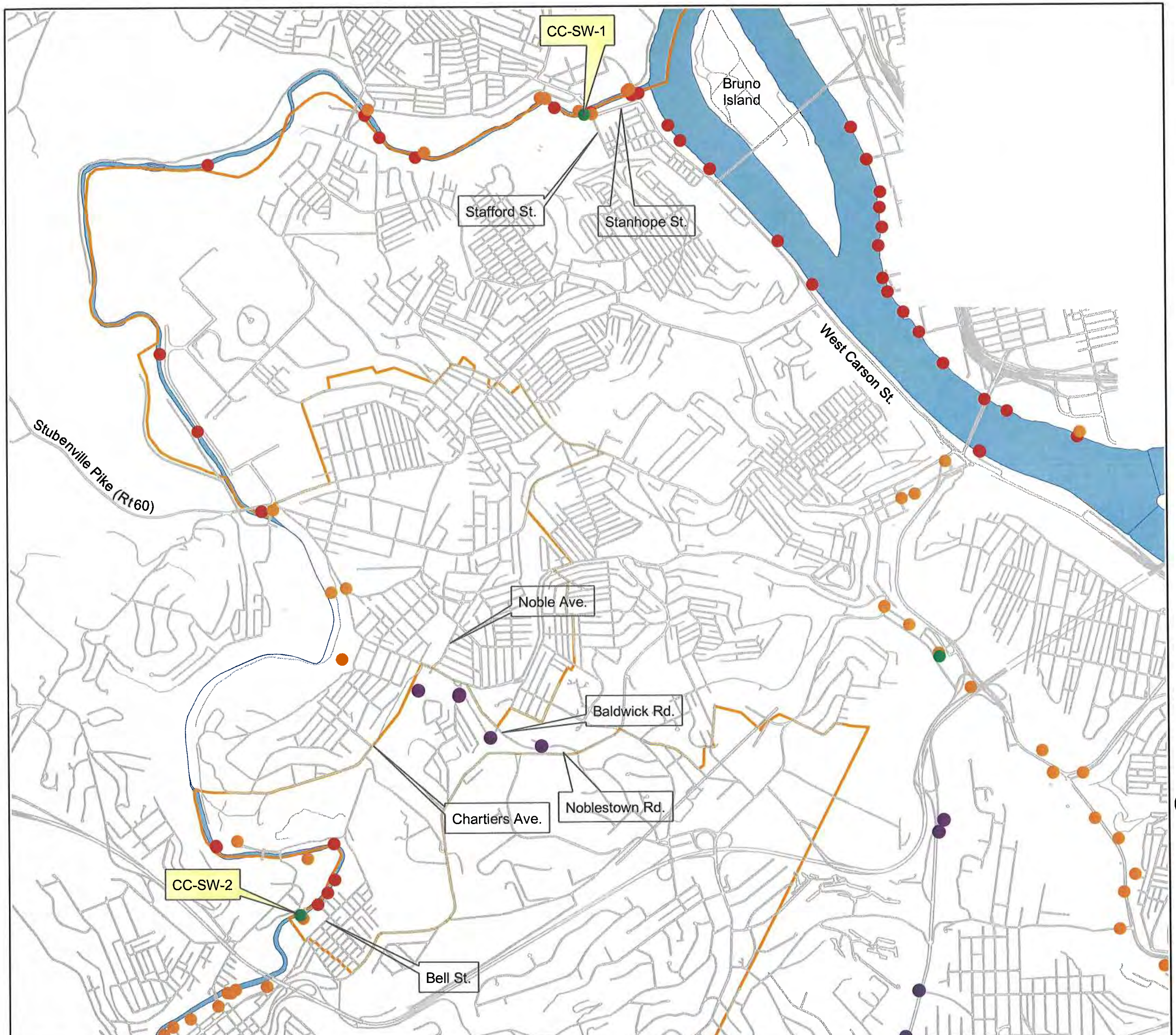


Photo E: CC-SW-2

ATTACHMENT C - APPENDIX B



Legend

- City of Pittsburgh
- Monitoring Location
- PWSA CSO
- PWSA Permitted ALCOSAN CSO
- ALCOSAN Permitted CSO

N E S W

0.5 0 0.5 Miles

Figure 2-3
Chartiers Creek Monitoring Locations
Technical Memorandum
December, 2006

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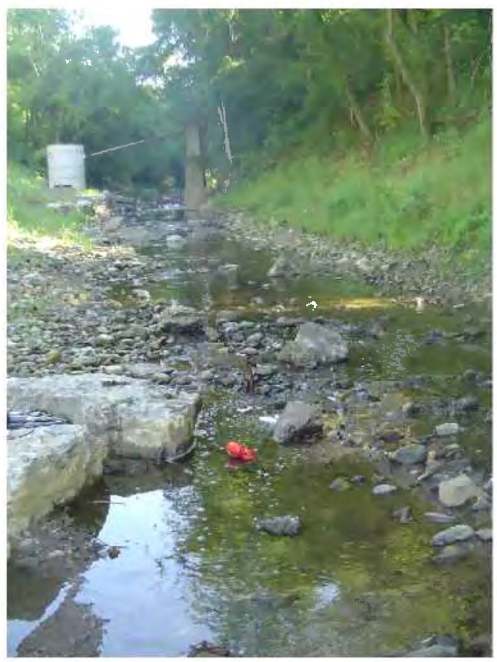
Quality Water Quality Service
Engineering & Construction Division

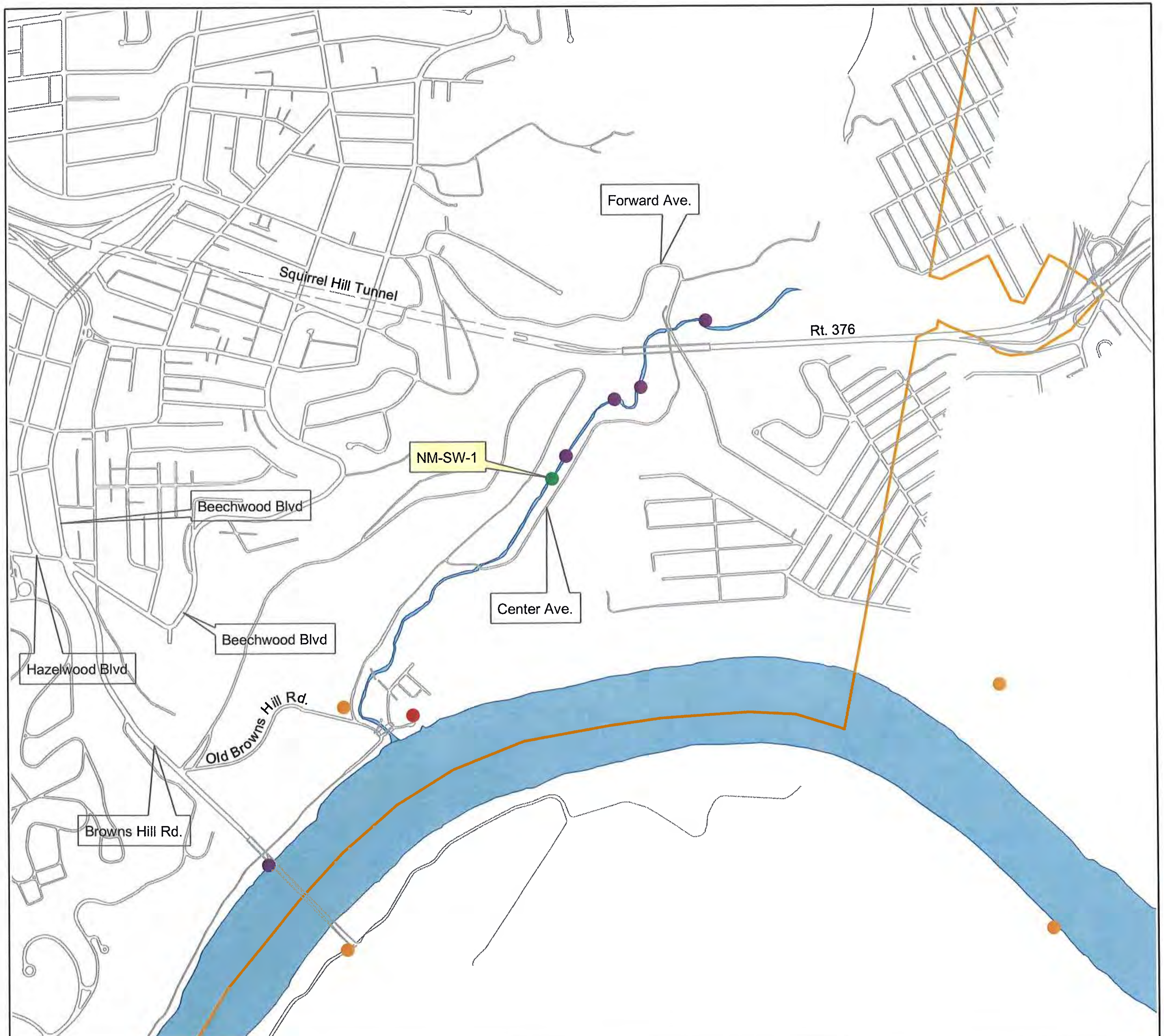
2.1.3 Nine Mile Run

The Nine Mile Run watershed encompasses approximately 6.5 square miles in area and lies in portions of the City of Pittsburgh, Edgewood Borough, Swissvale Borough, and Wilkinsburg Borough. Much of the stream (approximately two-thirds of the total length) is piped upstream but is open when it flows through Frick Park in the City of Pittsburgh. The watershed land use is mostly residential and covered with impervious surfaces with the exception of Frick Park which is wooded. Approximately 48,000 people live within the watershed boundaries (source: Nine Mile Run Watershed Association website; www.ninemilerun.org). There are 5 PWSA CSOs within the watershed. Nine Mile Run discharges to the Monongahela River. The monitoring location NM-SW-1 is shown on Figure 2-4 and lies in a portion of the stream that was recently reconstructed as part of a natural channel restoration project. Photos F and G show the monitor that was installed with the in-stream configuration.

Photo F: NM-SW-1

Photo G: NM-SW-1





Legend

- City of Pittsburgh
- PWSA CSO
- PWSA Permitted ALCOSAN CSO
- Monitoring Location
- ALCOSAN Permitted CSO

N
W E
S

0.25 0 0.25 Miles

Figure 2-4
Nine Mile Run Monitoring Location
Technical Memorandum
December, 2006

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service
Engineering & Construction Division

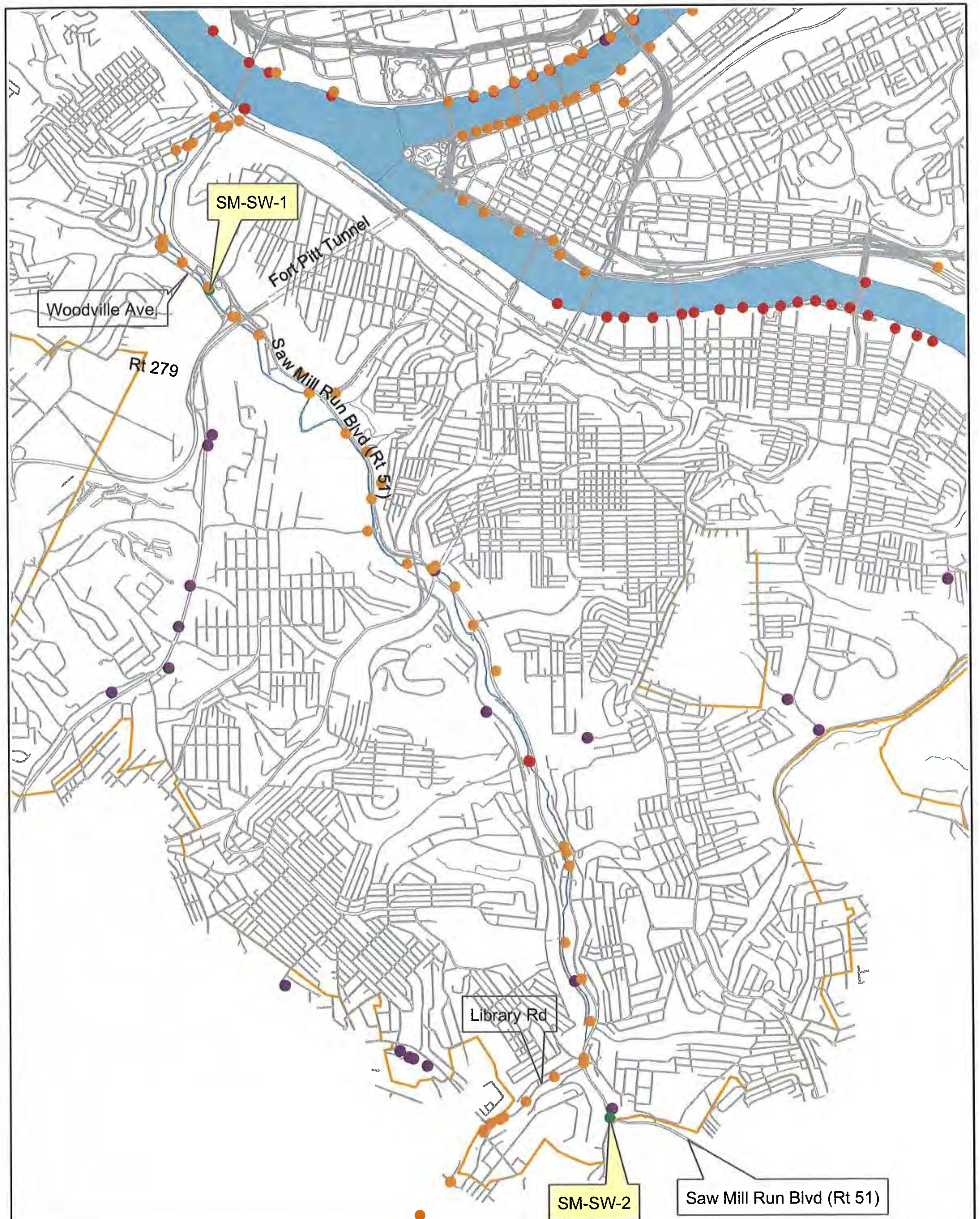
2.1.4 Saw Mill Run

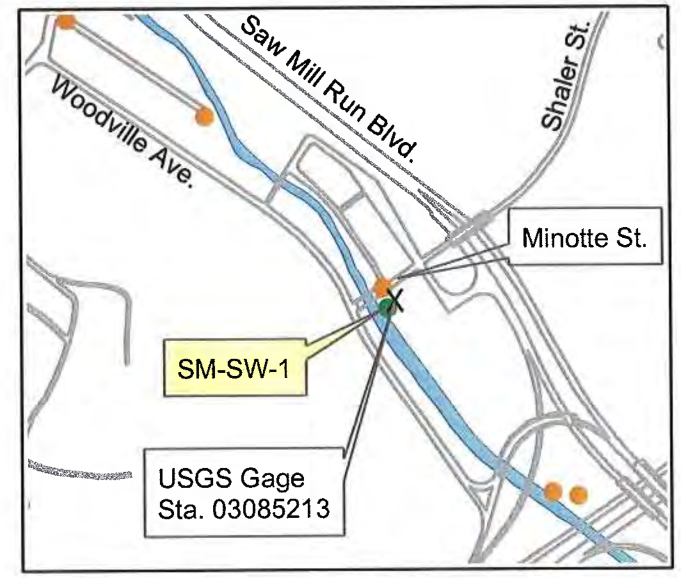
The Saw Mill Run sewershed (and watershed) is approximately 13,000 acres in area and is located in portions of the City of Pittsburgh, Baldwin Borough, Baldwin Township, Mount Oliver Borough, Scott Township, Brentwood Borough, Crafton Borough, Green Tree Borough, Ingram Borough, Whitehall Borough, Castle Shannon Borough, Dormont Borough, the Municipality of Bethel Park and the Municipality of Mount Lebanon. The sewershed includes residential, industrial, and commercial land use. Forty CSOs discharge to Saw Mill Run and its tributaries.

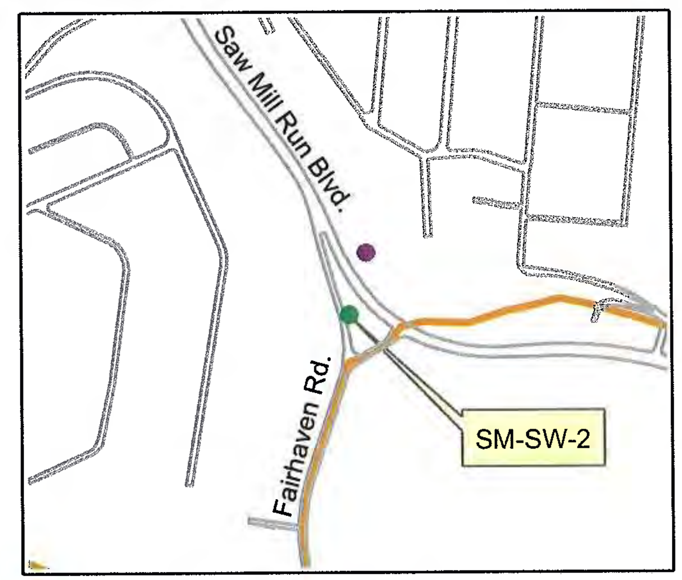
The two monitoring locations in Saw Mill Run are shown on Figure 2-5. SM-SW-1 is located in the downstream portion of the sewershed just upstream of ALCOSAN diversion chamber S-41. This is the same site as a USGS gage station where stream flow data is collected. Monitoring location SM-SW-2 is at the upstream boundary of the City of Pittsburgh and Whitehall Borough. This location was heavily impacted by abandoned mine drainage (AMD). Both monitors were installed with the in-stream configuration as shown in Photos H and I.

Photo H: SM-SW-1

Photo I: SM-SW-2







Legend

- City of Pittsburgh
- PWSA CSO
- PWSA Permitted ALCOSAN CSO
- Monitoring Location
- ALCOSAN Permitted CSO

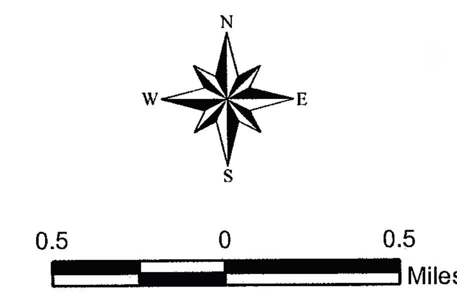


Figure 2-5
Saw Mill Run Monitoring Locations
Technical Memorandum
December, 2006

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service
Engineering & Construction Division

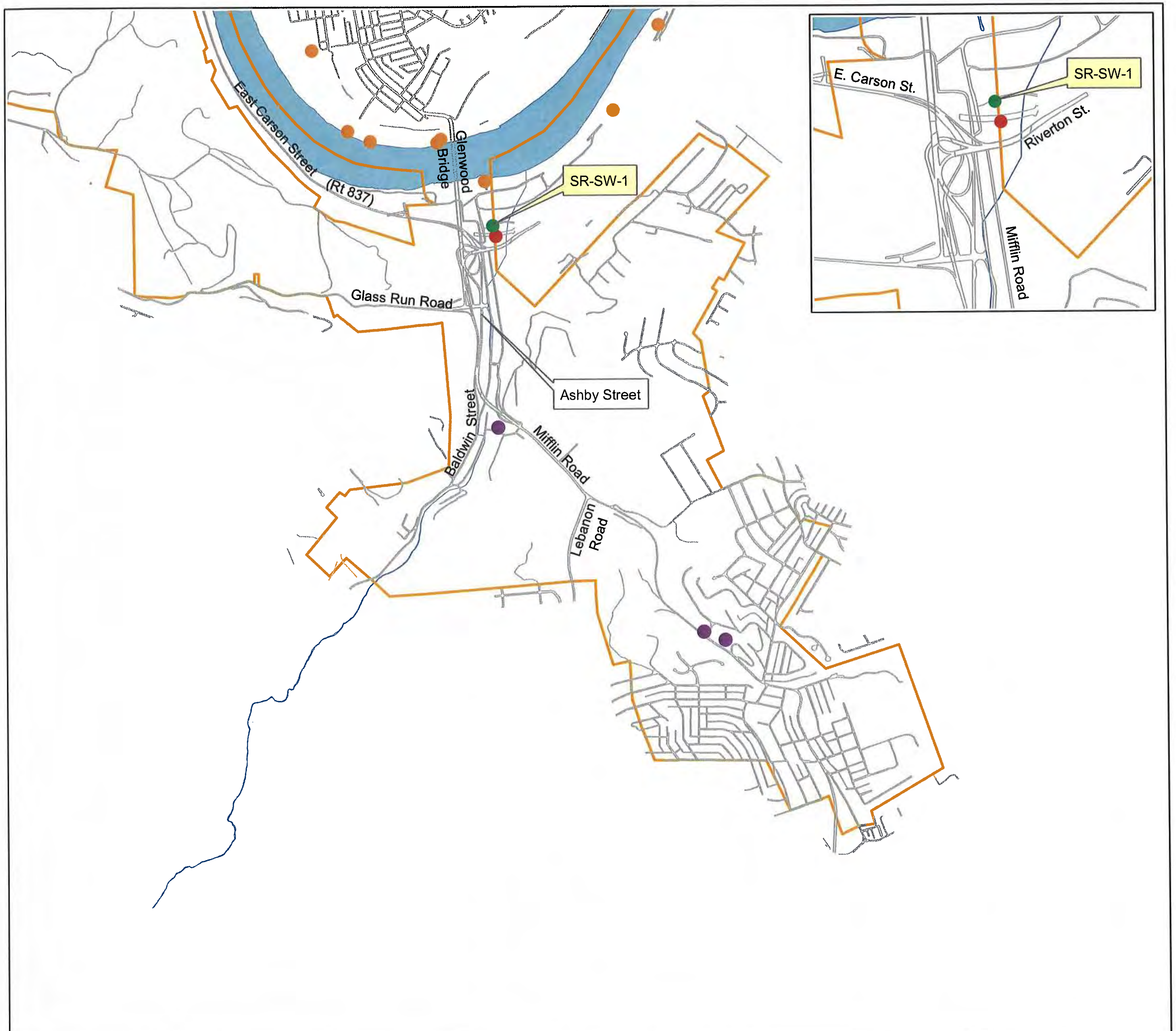
2.1.5 Streets Run

The Streets Run sewershed (and watershed) is approximately 6,950 acres in area and includes residential, commercial and industrial development. Portions of Baldwin Borough, Brentwood Borough, Pleasant Hills Borough, West Mifflin Borough, Whitehall Borough, and the City of Pittsburgh are included in the sewershed boundary. There are three PWSA CSOs in the sewershed that discharge to Streets Run. The sewer system connects to the ALCOSAN interceptor at the Monongahela River. The monitoring location (SR-SW-1) is shown on Figure 2-6 and in Photo J. This monitor was installed with the streambank installation configuration in a short section of open channel stream approximately 150 downstream of ALCOSAN diversion chamber M-42.

Photo J: SR-SW-1

2.2 WATER QUALITY MONITORING PARAMETERS

One of the major criteria used in selecting the most cost-beneficial control alternatives is the performance of the alternative in pollutant reduction. The pollutants selected for the load analysis need to be loads that actually result or contribute to potential non-attainment of water quality standards in the receiving stream. Pollutants typically found in CSOs include floatables, TSS, BOD, metals, bacteria, Phosphorus, Ammonia, oil & grease, etc. Impacts from these pollutants include dissolved oxygen depletion, public health impacts, and impairment of physical characteristics standards that include aesthetics. Evaluation of these pollutants by the project team led to the selection of dissolved oxygen (DO), pH, temperature and specific conductance as the pollutants to be monitored in this program.



Legend

- City of Pittsburgh
- PWSA CSO
- PWSA Permitted ALCOSAN CSO
- Monitoring Location
- ALCOSAN Permitted CSO

N
W E
S

0.5 0 0.5
Miles

Figure 2-6
Streets Run Monitoring Location
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Dissolved oxygen, pH, temperature and specific conductance of the ambient receiving waters were continuously monitored in-situ. These parameters were selected because they are considered indicators of the presence of pollutants that may have an impact on aquatic life. Some of the parameters are regulated by the Pennsylvania Department of Environmental Protection (PADEP) as listed in Table 2-2 and Attachment A.

DO is of primary interest for receiving stream monitoring because aquatic organisms cannot survive without oxygen. The regulatory minimum and average concentrations of DO (in milligrams per liter) depends on the designated stream use as listed in the Pennsylvania Code Chapter 93. Chartiers Creek, Saw Mill Run, Becks Run and Streets Run are listed as warm water fisheries (WWF) and have the following DO requirements:

- Minimum daily average of 5.0 mg/L and a minimum of 4.0 mg/L

Nine Mile Run is listed as a trout stocked fishery (TSF) and has the following DO requirements:

- For February 1 to July 31 of any year, minimum daily average of 6.0 mg/L; minimum of 5.0 mg/L
- For the remainder of the year, minimum daily average of 5.0 mg/L; minimum of 4.0 mg/L

DO depletion during wet weather likely indicates the impact of high organic loads (as measured in the lab by the surrogate parameter, biological oxygen demand or BOD) that may be attributed to sewage collection system overflows. If DO concentrations are below the corresponding water quality standards due to CSOs, then CSO control measures may need to be implemented to address this issue.

Temperature is related to the amount of DO that water can retain. As water temperature increases, the quantity of DO it can retain decreases. Temperature of water is also important because if aquatic organisms have prolonged exposure to temperatures outside their survival and spawning requirements, they can die or their life cycles can be impacted. Water temperature also impacts the amount of other dissolved gases that are retained in water, some of which can be harmful to aquatic life. Water temperature is affected by ambient air diurnal fluctuations, seasons, weather, water storage (e.g., dams or stormwater detention), or discharges of stormwater, combined sewer overflows, cooling water, or groundwater. There are regulatory limits for temperature in the streams.

The value of pH is an indicator of the balance of hydroxide and hydrogen ions. High or low pH can be harmful to aquatic life.

Conductivity is proportional to dissolved solids (cations and anions, or ionic strength) and is a surrogate parameter to indicate a source of pollution and is also the ability of water to conduct an electric current. Dissolved solids in water impact the solubility of oxygen gas (saturation concentration) that can be retained by water. A higher total dissolved solids (TDS) content of water will result in a lower saturation value of DO concentration. This parameter is used to evaluate the impact of wet weather events on receiving waters. There are no regulatory limits for conductivity. However, TDS has a water quality standard for receiving waters that have a designated use for potable water supply.

The regulatory requirements are summarized on Table 2-2. Note that some parameters are listed more than once. This is because there are different regulatory limits depending on the designated use of a stream.

Table 2-2
Regulatory Limits for Monitoring Parameters

Parameter	PADEP Regulatory Limit (Table 3 of PA Code Chapter 93.7)[1]	Critical Water Use[2]
Dissolved Oxygen	DO_2: Minimum daily average 5.0 mg/L; minimum 4.0 mg/L	Warm Water Fishery
Dissolved Oxygen	DO_3: For the period February 1 to July 31 of any year, minimum daily average 6.0 mg/L; minimum 5.0 mg/L. For the remainder of the year, minimum daily average 5.0 mg/L; minimum 4.0/L.	Trout Stocked Fishery
Conductivity	None	--
Temperature	$TEMP_2$: varies by time of year (see Table 3 PA Code Chapter 93 in Attachment A)	Warm Water Fishery
Temperature	$TEMP_3$: varies by time of year (see Table 3 PA Code Chapter 93 in Attachment A)	Trout Stocked Fishery
pH	6.0 to 9.0 inclusive	Cold Water Fishery, Warm Water Fishery, Trout Stocked Fishery, Migratory Fishes
Total Dissolved Solids [3]	500 mg/L monthly average; 750 mg/L maximum	Potable Water Supply

Notes:
1. The regulatory limits are applicable to all waters of the Commonwealth unless specific exceptions are made for a stream as listed in PA Code Chapter 93.9a-93.9z.
2. "Critical Use" is the most sensitive designated or existing use that the regulatory limit was developed to protect.
3. Total dissolved solids are not being directly monitored under this program.

The regulatory limits from Table 2-2 that are applicable to each stream that is being monitored are determined by the designated stream uses as defined by PA Code Chapter 93.9a through 93.9z. The designations of the streams are presented in Table 2-3 below.

Table 2-3
PA Code Chapter 93 Stream Designations

Stream	Stream Designation
Becks Run	Warm Water Fishery (minus potable water supply standards)
Chartiers Creek	Warm Water Fishery
Nine Mile Run	Trout Stocked Fishery (minus potable water supply standards)
Saw Mill Run	Warm Water Fishery (minus potable water supply standards)
Streets Run	Warm Water Fishery (minus potable water supply standards)

2.3 MONITORING EQUIPMENT

Monitoring units were obtained from YSI Environmental, Yellow Springs, Ohio for this project. YSI 600-XLM continuous monitoring units were installed in the streams as described above. A YSI 650 handheld unit was used in conjunction with the sondes to download data in the field and to transfer it to computer for data management and analysis. Each sonde had three probes: DO probe, pH probe, and one probe that measures specific conductance and temperature. Equipment specifications are included in Attachment B. The sondes collect data at 15-minute intervals.

2.4 DATA COLLECTION AND MANAGEMENT

Data was downloaded in the field on a weekly basis. The sondes were briefly removed from the protective pipes, connected to the YSI 650 handheld unit and downloaded to the YSI 650. Data files from each site had a unique name to avoid overwriting of data. The data was downloaded from the YSI 650 to a computer using EcoWatch for Windows which is a program developed to be used with the YSI equipment. The data was then exported to Microsoft Excel files for data management and analysis. Separate Excel files were maintained for each site. Each file has separate worksheets for the data in table form, graphs (one graph for each month), dry weather analysis tables, field QA/QC data and field notes, flow data (for Chartiers Creek and Saw Mill Run sites only), and rainfall data. Each graph worksheet has a rainfall graph, a flow graph (for Chartiers Creek and Saw Mill Run sites only), a graph showing both temperature and DO, and a graph showing specific conductance. QA/QC field data was also plotted on the graphs.

2.5 FIELD QA/QC PROCEDURES

The sonde units were calibrated and maintained on a monthly basis by removing them from the field. DO membranes were replaced, and the probes cleaned and calibrated. The DO probes were reconditioned as necessary. The sondes were then redeployed to the sites the next day. The same sondes were redeployed at the same site for consistency. When data was downloaded, the condition of the probes was checked and cleaned. Other field conditions were also noted such as relative depth of stream flow, presence of algae growth, weather conditions, and sedimentation on the probes. The batteries were changed every three to four weeks. The downloaded data was reviewed on a weekly basis to determine if field conditions or equipment readings warranted a change of methodology in data collection, or if equipment was malfunctioning.

A separate YSI 600-XLM unit was calibrated with standard solutions by the field crew prior to each data collection event. This unit was used at each location to collect independent water quality data from the stream adjacent to the stream monitor. The quality control data and field notes were used to do a cursory evaluation of the data set to determine if the data was accurate (representative of actual conditions); or to determine if changes to the data collection methodology or installation configuration needed to be made.

3.0 BACKGROUND DATA COLLECTION

Background data relating to the sewersheds were collected so that the monitoring data could be correlated with the existing conditions. These data are described in the following sections.

3.1 FLOW DATA

The data presented includes USGS flow data that was downloaded from the USGS website for flow gages. A USGS gage station is located along Chartiers Creek (USGS 03085500 Chartiers Creek at Carnegie, PA: latitude 40°24'02", longitude 80°05'48"). The flow data from this gage was used in the evaluation of the data for CC-SW-1 and CC-SW-2. This gage station is approximately 1.6 miles upstream of the CC-SW-2 location and collects data at one-hour intervals. Another USGS gage station is located on Saw Mill Run at the same location as SM-SW-1 (USGS 03085213 Sawmill Run at Duquesne Heights near Pittsburgh, PA: latitude 40°25'58", longitude 80°01'47"). This gage data was used in the evaluation of the data for SM-SW-1, and SM-SW-2. This gage station collects data at 15-minute intervals. The flow data was downloaded on a monthly basis from the USGS website for incorporation into the receiving water quality database.

3.2 RAINFALL DATA

Rainfall data was obtained from the 3 Rivers Wet Weather (3RWW) website. As it was made available, the calibrated radar rainfall data was downloaded and incorporated into the receiving water quality database. A centrally located pixel for each watershed was selected as representative of the average rainfall for each of the five watersheds. During the course of the field program, uncalibrated (historic rain gage data) was used in the weekly review of the data in order to determine if data is accurate and representative of field conditions. The uncalibrated gage data in the database was replaced with the calibrated rainfall data as it became available. The pixels used to represent the rainfall in each sewershed are presented in Table 3-1. Their locations are shown on Figure 3-1.

Table 3-1
Calibrated Radar Rainfall Data Sites

Monitoring Site	Representative Calibrated Radar Rainfall Pixel
BR-SW-1	PX-148, PY-143
CC-SW-1 and CC-SW-2	PX-139, PY-144
NM-SW-1	PX-156, PY-139
SM-SW-1 and SM-SW-2	PX-145, PY-144
SR-SW-1	PX-150, PY-146

ATTACHMENT C - APPENDIX B

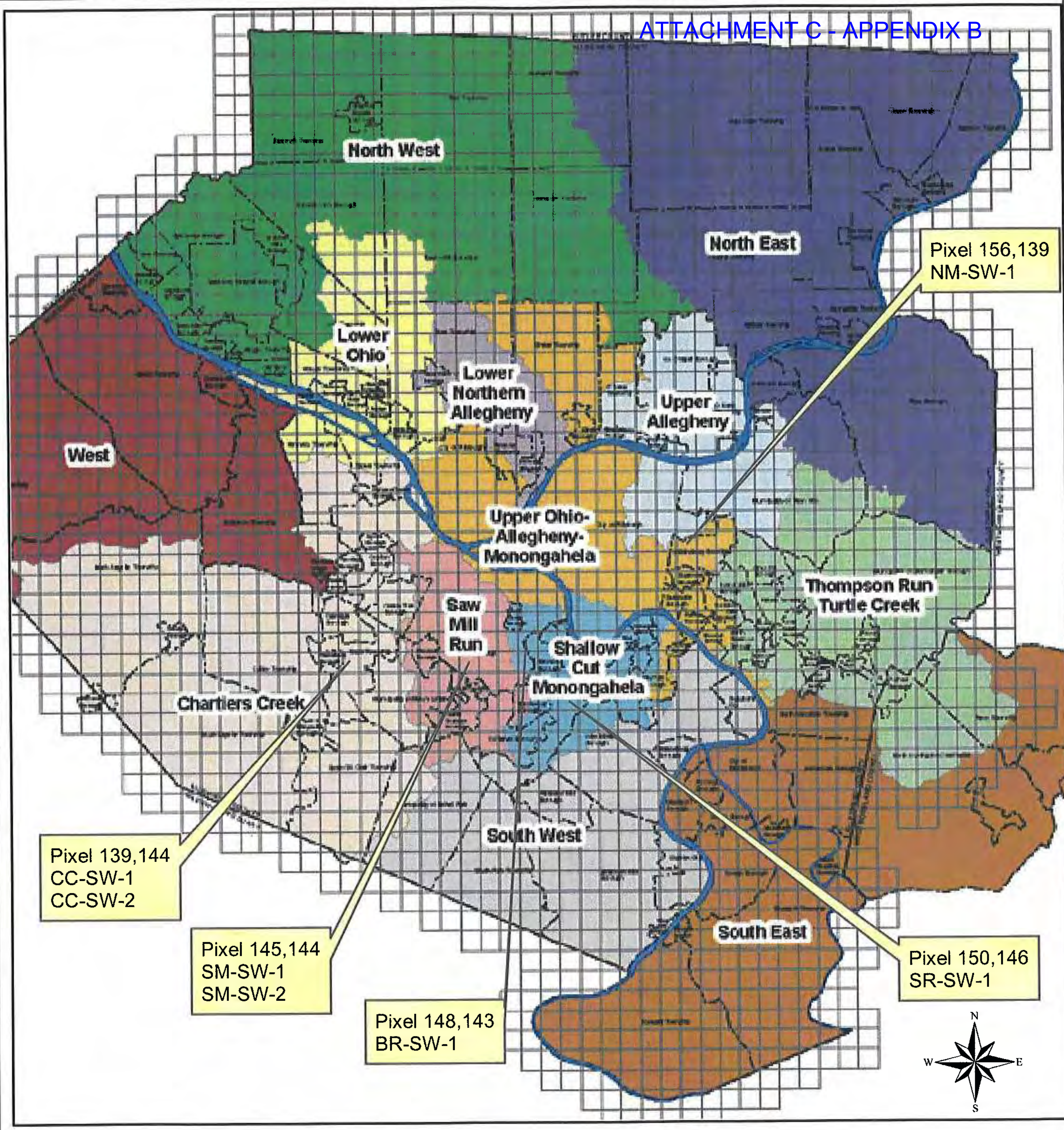

Figure 3-1
Rainfall Pixel Locations
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3.3 OVERFLOW EVENTS

For the purposes of the analysis, it was assumed that overflows were occurring during rainfall events of cumulative rainfall of 0.5 inches or more. Discrete storm events were defined as separate events if there was at least 6 hours between rainfall. The occurrence of CSO events was considered when selecting which wet weather events to analyze. The events which were assumed to have caused overflows in each stream are summarized in Table 3-2. A complete summary of rainfall events is included in Attachment C.

Table 3-2
Probable Storm Events Causing CSOs

Month	Start Date/Time of Storm Event	Becks Run PX-148/PY143 Total Rainfall, in	Chartiers Creek PX-139/PY-144 Total Rainfall, in	Nine Mile Run PX-156/PY-139 Total Rainfall, in	Saw Mill Run PX-145/PY-144 Total Rainfall, in	Streets Run PX-150/PY-146 Total Rainfall, in
June	6/2/2006 14:30		1.1539	1.3099	0.9029	0.9160
	6/19/2006 6:15	0.5590				
	6/19/2006 21:15	0.6360		0.5250		0.9790
	6/22/2006 2:30				0.6900	
	6/26/2006 23:15	0.6779	0.6990	0.9079	0.5589	0.5980
July	7/4/2006 1:15	0.6619	1.3938	0.7460	1.0509	1.3020
	7/12/2006 2:30	1.0910		1.1400	1.1250	1.4797
	7/30/2006 14:45	0.9490	1.2569		1.1160	1.1420
August	8/14/2006 21:15					0.5740
	8/19/2006 16:45				0.5180	
	8/27/2006 8:45	0.7140		0.6610	0.5130	0.7442
September	9/1/2006 18:15	1.0289		0.625	0.9958	0.9099
	9/12/2006 9:15	1.066	1.3869	1.3248	1.159	1.064
	9/13/2006 14:45	0.8099		1.3799		1.224
	9/28/2006 7:15		0.592			

4.0 DATA QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance and Quality Control (QA/QC) procedures were utilized to ensure that the data used in the analysis accurately depicts the conditions in the receiving streams.

4.1 PRELIMINARY REVIEW OF DATA

Data was downloaded and QA/QC checks were performed on a weekly basis. Upon return to the office, the data was downloaded into EcoWatch and exported to Excel for cursory review. The data was checked to see if it was correlating with the QA/QC samples that were collected. If not, the cause of the discrepancy was determined by the use of the diagnostic parameters that are automatically collected by the sondes. If certain parameters were out of acceptable ranges, (pH millivolts or DO charge), appropriate maintenance was performed on the equipment to resolve the discrepancy.

4.2 RAW DATA AND DATA ADJUSTMENT

The raw data for DO was adjusted based on QA/QC data that was collected on a weekly basis. The DO probe in the monitor is subject to fouling because the probe measures DO concentrations with a permeable membrane method. Build up (fouling) of materials such as silt, iron precipitate or other substances on the membrane could reduce permeability of the membrane and affect readings. The in-stream data trends were compared to the QA/QC data points for DO. In some cases, the DO QA/QC data points were more than 0.5 mg/L higher or lower than the data. If this trend occurred for more than one QA/QC cycle, the data was adjusted with linear or straight adjustment. Linear adjustment calculations were performed between the QA/QC end points where an increasing difference in QA/QC values and in-stream data were observed (drift was occurring) over a set of data. Straight adjustment (shifting an entire set of data up or down by the same value) to a set of data was performed when there was no increasing difference between the QA/QC data and in-stream data, but a consistent difference was observed.

The specific conductance and temperature data were not adjusted because the QA/QC data for these parameters were not significantly different than the in-stream data in most cases, and because these parameters were used as a cross check against DO responses to storm events and trends in DO data. The actual values of the data were not compared to a regulatory limit. Therefore, observation of trends was more important than actual values for specific conductance and temperature.

Graphs of the adjusted data are included in Attachment D. Tables of the data (raw and adjusted), calibrated radar rainfall data, and USGS gage station data, and tables summarizing the QA/QC data and field notes for each site are included on the CD included with this report as Attachment E.

4.3 SELECTION OF REPRESENTATIVE DATA

Field notes and observations in data trends for temperature and specific conductance were used to determine if a portion of data should not be used in the analysis because it was affected by field conditions. Two problems were encountered in the field that affected the readings of the sondes that were installed using the in-stream configuration. 1) The sondes were occasionally buried in sediment; and 2) the sondes were occasionally propped up out of the water. Both problems occurred while high flows were receding. Sediment got into the horizontal protective pipes during some storm events and covered the probes. This was indicated in the data with a dampened daily fluctuation of temperature. In some cases, the protective pipe, that was free to float on the end of a chain in stream flow, settled on a high rock as the storm flow receded leaving the probes out of the water during normal flow. This was indicated in the data by the specific conductance reading 0 mS/cm, and occasionally the temperature readings dramatically increasing in range from the normal daily fluctuation pattern.

DO data corresponding to field notes and temperature and conductivity data reflecting these conditions were considered suspect and were not used in the analyses. The QA/QC readings and field notes are included in Attachment F.

5.0 DATA ANALYSIS AND RESULTS

This section presents the tools that were used in order to evaluate the data. The results for each monitoring location are also presented.

5.1 DATA TRENDS

General trends in data were observed during dry weather and wet weather that were common for all of the monitoring locations with some exceptions, as noted below. The dry weather trends were compared with wet weather trends during the analysis to determine when an outside influence was having an impact on the receiving water.

5.1.1 Dry Weather Trends

Continuous water quality data was collected in order to understand existing water quality conditions during dry and wet weather periods. It is important to differentiate between intermittent wet weather related water quality issues and ongoing non wet weathered related issues. The review of dry weather data could show some of these ongoing issues that could be present in the receiving stream after control of wet weather overflows.

The temperature and DO data depict similar diurnal patterns. During dry weather, both data sets depict predictable increases and decreases and ranges throughout a given 24-hour period. This diurnal trend can be expected for these shallow streams (4 to 16 inches deep during normal flow at monitor locations) and would quickly respond to ambient temperature changes. The DO saturated concentration is inversely proportional to the water temperature and the DO concentration takes time to change with temperature. Therefore, the DO diurnal patterns lag behind the temperature pattern with the DO maximums lagging behind the temperature minimum and the DO minimum concentrations lagging behind the temperature maximums. The lowest DO concentrations and highest temperatures occurred during July and August.

Specific conductance generally remained steady during dry weather with no discernible diurnal patterns. The values ranged from 1.0 to 1.6 mS/cm, depending on the monitoring site.

An exception to the usual temperature and DO data was found in Saw Mill Run (SM-SW-2). The temperature data at this upstream Saw Mill Run location has a diurnal pattern similar to the other monitoring locations. However, the water temperature is consistently between 50° and 60° Fahrenheit during dry weather, approximately 10 degrees lower than the other monitoring locations. This is because the flow in this portion of the stream is heavily impacted by mine drainage. The DO patterns for this location are also dissimilar to the other locations because iron oxide quickly fouled the sonde probes. These conditions affected the DO readings in particular.

A downward drift is evident between each site visit. An additional maintenance was performed on this sonde to remove the iron oxide, generally twice each week. After downloading data and equipment maintenance, the DO readings correlated with QA/QC readings because the probes were cleaned.

The Streets Run location also had slightly different patterns than the other sites. Temperature and DO data have diurnal patterns but consistently showed more than one peak even during dry weather. Specific conductance showed spikey decreases that correspond to the temperpature peaks during dry weather. This may be indicative of discharges from industrial outfalls upstream of the monitoring site.

5.1.2 Wet Weather Trends

Generally, when storm events occur, the temperature and DO patterns are disrupted. The diurnal DO variations show a dampening and depression effect during and for some time after storm events.

The specific conductance sharply decreases at the beginning of storm events and tails rebounds to the pre-storm level at the end of the storm event. In cases where storm events are only several hours apart, the conductivity may not recover to its normal level before sharply decreasing again. The sharp response in conductivity in the shallow streams to a storm event can be expected because of the “flashy” nature of the stream hydrology. A flashy hydrograph is common in watersheds where streams have been straightened, the flood plains filled, and the surrounding topography is steep. Prior to this study, it was expected that the conductivity would go up during storm events. However, the decrease in conductivity is a repeated pattern for every storm event at all of the sites. From the data, it has been deduced that the quantity of flow during storm events (from 3 to 5 times the base flow in Chartiers Creek and 10 to 100 times the base flow for the other streams) dilutes the effects of suspended solids from run off and sediment transport, thus lowering the conductivity.

An exception to these trends is found in Saw Mill Run at SW-SM-2. Here, the stream temperature also quickly responds during storm events, but the water temperature sharply increases. This is a different trend from the other monitoring locations which experience a dampening effect in the temperature diurnal patterns. This occurs because the normal temperature of the stream is lower than the stormwater runoff. DO readings were also observed to increase during some storm events but decrease during other storm events. Whether the DO readings increased or decreased during a storm event depends on how much drift had occurred due to fouling before the storm event. When a significant amount of drift has occurred before a storm, it appears that the iron precipitate is washed off the probe and the DO readings increase toward the actual concentration.

5.2 DRY WEATHER ANALYSIS

After the data was adjusted as described above, the diurnal variation in DO was calculated for full 24-hour periods of dry weather. Periods when the monitor was out of the water (this occurred several times at some locations and can be determined by examining the specific conductance readings) were discounted. Note that, for SM-SW-2, only dry weather data, where fouling had not significantly depressed the DO readings, was considered.

The average daily DO and the minimum DO, and the difference between these two values, for a given 24-hour dry weather period were calculated. The average daily dry weather DO concentrations were calculated to determine if DO concentrations were below regulatory limits during dry weather. If this were the case, other causes of DO depletion besides CSOs are likely present in the stream which would need to be addressed instead of or in addition to implementing CSO controls. The diurnal variation was calculated to determine if there were significant fluctuations in the DO concentrations throughout a 24-hour period. Significant fluctuations in DO concentration during dry weather may indicate something in the environment (such as excess algae growth, nutrient loading, or benthic activity) that are causing lower or higher DO concentrations than normal. Diurnal variations of greater than 1.0 mg/L may indicate such conditions. Monthly dry weather DO tables for each monitoring location are included in Attachment G. In addition to the calculations described above, the tables include the following monthly information for dry weather periods:

- Minimum Average Daily DO
- Minimum DO
- Average Daily DO
- Average of daily diurnal variations
- Minimum of daily diurnal variations
- Maximum of daily diurnal variations
- Maximum DO

Table 5-1 summarizes the results of the dry weather analysis for each location. From the table it can be seen that DO depletion (concentrations are below the minimum daily DO regulatory limits) is occurring in Chartiers Creek and Saw Mill Run during dry weather periods in July and/or August. This indicates that other sources or causes of DO depression may be present in these sewersheds. Significant fluctuations in DO concentrations (maximum daily diurnal variation) are also occurring in Becks Run, Chartiers Creek, Nine Mile Run, and Saw Mill Run during dry weather periods. This is also an indication that DO concentrations are affected by conditions in these sewersheds other than CSOs.

Table 5-1
Dry Weather Analysis Summary

Monitoring Location	Month	Minimum Daily Avg DO for Month[1]	Minimum Daily DO for Month[1]	Average of Daily Diurnal DO for Month	Minimum Daily Diurnal Variation for Month	Maximum Daily Diurnal Variation for Month[2]	Maximum DO for Month
BR-SW-1	June	9.20	7.88	0.89	0.31	1.45	11.30
	July	7.81	7.38	0.37	0.20	0.53	8.72
	August	6.91	6.42	0.50	0.23	1.68	10.44
	September	8.92	8.19	0.66	0.19	1.38	11.62
CC-SW-1	June	9.21	5.91	2.80	1.43	3.75	14.25
	July	4.86	0.14	3.35	1.19	6.07	18.16
	August	9.25	6.49	2.35	1.58	3.02	14.52
	September	8.98	7.54	1.49	1.27	1.73	13.43
CC-SW-2	June	9.30	6.67	2.19	1.55	2.71	13.71
	July	5.50	2.56	1.84	1.03	2.94	10.96
	August	6.08	3.96	2.10	1.02	4.23	14.21
	September	8.76	7.12	1.83	0.97	2.32	13.49
NM-SW-1	June	8.37	6.61	1.22	0.80	1.79	10.81
	July	7.47	6.58	0.94	0.58	1.23	9.80
	August	6.68	5.48	1.09	1.00	1.20	9.24
	September	8.05	7.53	0.96	0.33	1.51	12.18
SM-SW-1	June	8.56	6.93	1.07	0.73	1.63	10.42
	July	6.04	3.63	1.12	0.56	2.57	10.01
	August	6.99	6.38	0.83	0.10	1.66	10.48
	September	8.47	7.58	0.99	0.60	1.26	11.17
SM-SW-2	June	9.96	9.44	0.42	0.31	0.52	10.50
	July	7.88	7.48	0.30	0.25	0.40	9.12
	August	4.35	3.99	0.42	0.18	0.97	8.99
	September	5.10	4.53	0.36	0.24	0.57	9.74
SR-SW-1	June	8.83	8.15	0.58	0.04	0.98	10.90
	July	6.47	5.35	0.60	0.27	2.39	9.79
	August	6.97	6.03	0.53	0.21	0.95	9.79
	September	9.82	9.35	0.32	0.24	0.47	10.30

Notes:

1) Red indicates out of compliance with the regulatory limit. The minimum daily average for all streams (except for Nine Mile Run in June and July) is 5.0 mg/L. The minimum daily average for Nine Mile Run in June and July is 6.0 mg/L.
The minimum daily regulatory limit for DO for all streams (except for Nine Mile Run in June and July) is 4.0 mg/L.The minimum daily regulatory limit for DO in June and July for Nine Mile Run is 5.0 mg/L.
Depressed DO concentrations during dry weather indicates DO depression may be caused by sources other than CSOs.

2) Yellow indicates a diurnal variation of more than 1 mg/L during dry weather. This may indicate variations in DO for reasons other than CSOs.

5.3 WET WEATHER ANALYSIS

Examples of responses to wet weather events in each of the receiving streams are presented in Figures 5-1 through 5-7. The storms were selected based on QA/QC data (to ensure that accurate data was being depicted) and when CSO events were mostly likely occurring. Storm events that did not cause probable CSO events were also shown if there was a response in DO or specific conductance. A summary of these storm events that were evaluated is presented in Table 5-2. Data graphs from all of the selected wet weather events for each site are presented in Attachment F.

Figure 5-1 shows a typical response to a wet weather event when a CSO was probably occurring in Becks Run. There is a decrease in specific conductance that corresponds to each period of rainfall. The temperature and DO patterns are disrupted and depressed during these periods, but DO concentrations do not go below the regulatory limit.

Typical responses to wet weather events at the two locations in Chartiers Creek (CC-SW-1 and CC-SW-2) are shown in Figures 5-2 and 5-3, respectively. Both locations show similar responses in DO, temperature and specific conductance. With increased stream flow, DO and specific conductance decrease. Temperature fluctuations are flattened. DO concentrations decreased to below the regulatory limit.

Figure 5-4 shows a typical response to a wet weather event in Nine Mile Run. The DO pattern is disrupted and the DO concentration goes slightly below the regulatory limit. Temperature patterns are slightly disrupted and specific conductance decreases.

Figures 5-5 and 5-6 show typical responses to wet weather events at the Saw Mill Run locations (SM-SW-1 and SM-SW-2), respectively. Specific conductance decreases with each period of rainfall at both sites. At SM-SW-1, the DO pattern is disrupted and the DO concentration drops below the regulatory limit. There is a slight lag time between the peak flow and the DO depression below the regulatory limit. The temperature pattern is flattened. At SM-SW-2, the DO concentration drops below the regulatory standard in response to the larger storm event (on July 5) but actually increases during the smaller storm event on July 4. Note that, prior to the storm event on July 4, the DO is already below regulatory limits. This is due to an accumulation of iron oxide precipitate on the DO probe that results in a downward drift in DO concentrations during dry weather. During small storms, the precipitate is washed off and the DO readings increase. During the larger storms, the precipitate is washed off, but the DO concentration drops due to impacts from a probable CSO event. At SM-SW-2, the temperature actually increases in response to storm events because the stream flow is largely comprised of colder water from a mine discharge.

A typical response to a wet weather event in Streets Run is shown in Figure 5-7. This figure shows a decrease in specific conductance with each peak in rainfall. The DO and temperature patterns are disrupted. DO concentrations are depressed but do not fall below the regulatory limit.

Table 5-2
Wet Weather Analysis Summary

		BR1		CC1		CC2		NM1		SM1		SM2		SR1	
	Storm Event Start Date/Time	PX-148 /PY143 Total Rainfall, in	Storm Resulted in DO Below Regulatory Limit[1]	PX-139 /PY-144 Total Rainfall, in	Storm Resulted in DO Below Regulatory Limit[1]	PX-139 /PY-144 Total Rainfall, in	Storm Resulted in DO Below Regulatory Limit[1]	PX-156 /PY-139 Total Rainfall, in	Storm Resulted in DO Below Regulatory Limit[1]	PX-145 /PY-144 Total Rainfall, in	Storm Resulted in DO Below Regulatory Limit[1]	PX-145 /PY-144 Total Rainfall, in	Storm Resulted in DO Below Regulatory Limit[1]	PX-150 /PY-146 Total Rainfall, in	Storm Resulted in DO Below Regulatory Limit[1]
June	6/1/2006 17:00	0.1580	No	0.0940	Yes	0.0940	Yes	0.4210	Yes	0.1280	No	0.1280	No	0.1340	No
	6/2/2006 14:30	0.3550		1.1539		1.1539		1.3099		0.9029	No	0.9029	Yes	0.9160	
	6/3/2006 14:45	0.2353		0.4239		0.4239		0.3000		0.1699	Yes	0.1699		0.2530	
	6/4/2006 10:30	0.1435		0.0731		0.0731		0.1119		0.0675	Yes			0.1719	
	6/6/2006 15:45			0.2106		0.2106									
	6/19/2006 6:15	0.5590	No	0.0500	Yes	0.0500	Yes	0.4570	No	0.4200	No			0.2240	No
	6/19/2006 21:15	0.6360		0.0589		0.0589		0.5250	Yes	0.4800	No			0.9790	No
	6/22/2006 2:30	0.4290	No	0.4569	Yes	0.4569	Yes	0.4890	No	0.6900	No	0.6900	No	0.3200	No
	6/22/2006 17:00	0.0530		0.0210		0.0210		0.0540	No	0.0650	No	0.0650	No	0.0860	No
	6/23/2006 8:45	0.1980		0.1960		0.1960		0.1840						0.2000	No
	6/25/2006 12:45			0.0114	Yes	0.0114	Yes								
	6/26/2006 23:15	0.6779	No	0.6990	Yes	0.6990	Yes	0.9079	No	0.5589	Yes	0.5589	No	0.5980	No
July	7/2/2006 23:15	0.1039		0.0991		0.0991		0.0819		0.1514		0.1514		0.0851	
	7/4/2006 1:15	0.6619	No					0.7460	No	1.0509	Yes	1.0509	Yes	1.3020	No
	7/12/2006 2:30	1.0910	No	0.6100	Yes	0.6100	Yes	1.1400	Yes	1.1250	No	1.1250	Yes	1.4797	No
	7/27/2006 13:45	0.1850	No	0.0290	Yes			0.3160	No	0.1850	Yes	0.1850	No	0.1530	No
	7/28/2006 6:45	0.3244	No	0.2450				0.1491		0.4039	Yes	0.4039	No	0.3714	No
	7/30/2006 7:15	0.0675	No					0.1938	No					0.0013	No
	7/30/2006 14:45	0.9490	No					0.4409	Yes	1.1160	Yes			1.1420	No
August	8/14/2006 21:15			0.1740	Yes			0.1930	No	0.1569	No	0.1569	No	0.5740	No
	8/19/2006 16:45	0.4690	No	0.4996	Yes	0.4996	Yes	0.4940	Yes	0.5180	Yes	0.5180	No	0.2220	No
	8/27/2006 8:45	0.7140	No					0.6610	No	0.5130	No	0.5130	No	0.7442	No
	8/28/2006 15:30	0.1436	No					0.1539	No			0.1439	No	0.1600	No
September	9/1/2006 18:15	1.0289	No	0.56	No	0.5600	No	0.625	No	0.9958	No	0.9958	No	0.9099	No
	9/12/2006 9:15	1.066	No	1.3869	No	1.3869	Yes	1.3248	No	1.159	No	1.1590	No		
	9/13/2006 14:45	0.8099	No	0.4269		0.4269		1.3799		0.436	No				

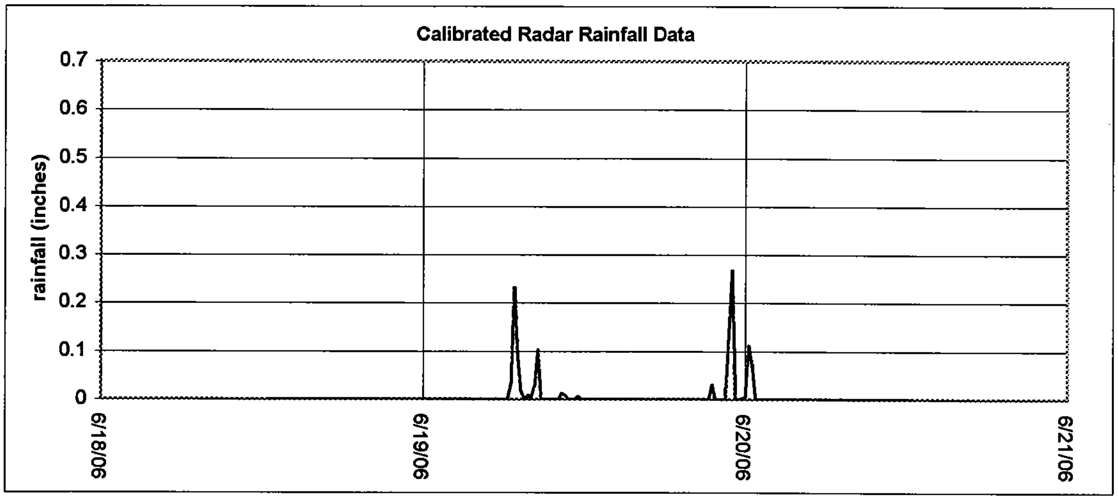
Notes:

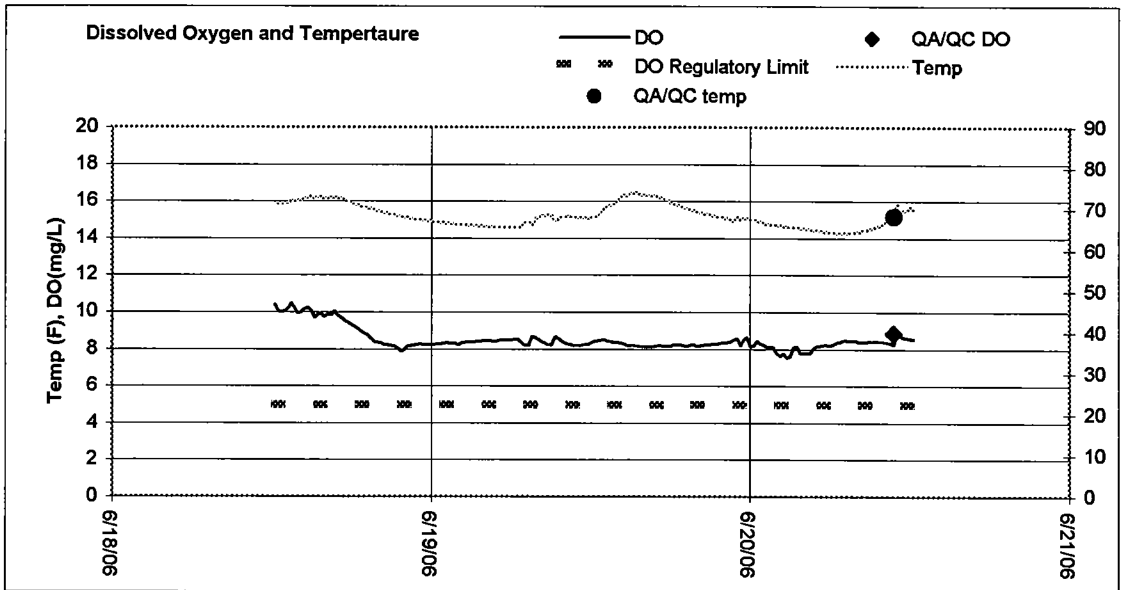
(shaded) Probable CSO event for storms with more than 0.5 inches of rainfall during one event.

Storm events are separate if there are 6 hours or more between rainfall.

1) The minimum daily average for all streams (except for Nine Mile Run in June and July) is 5.0 mg/L. The minimum daily average for Nine Mile Run in June and July is 6.0 mg/L.

Figure 5-1
Example Storm Graph Becks Run
BR-SW-1
(Probable CSO)





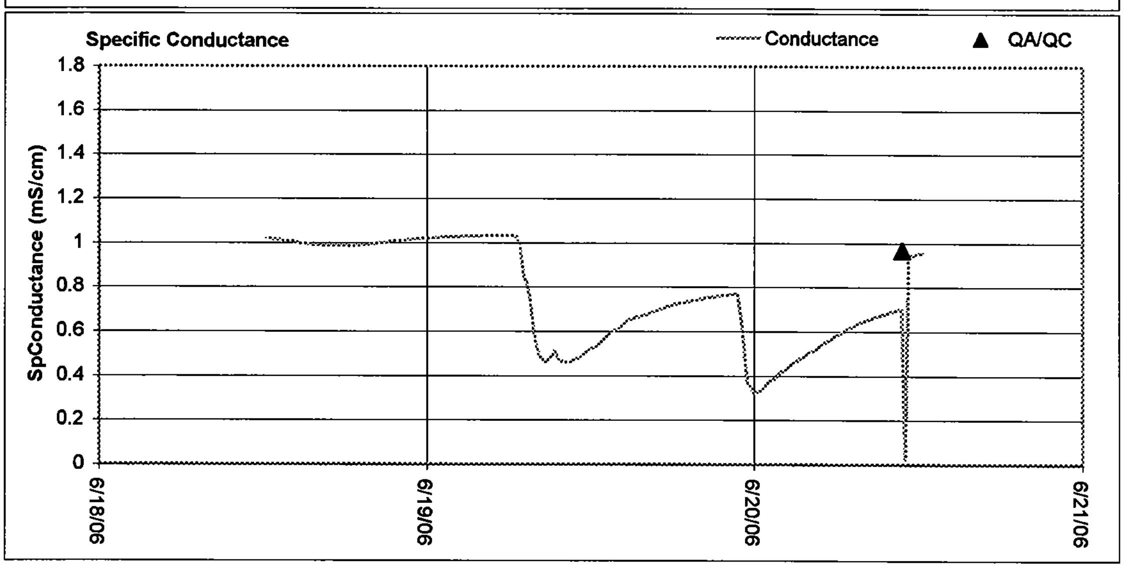


Figure 5-2
Example Storm Graph Chartiers Creek
CC-SW-1

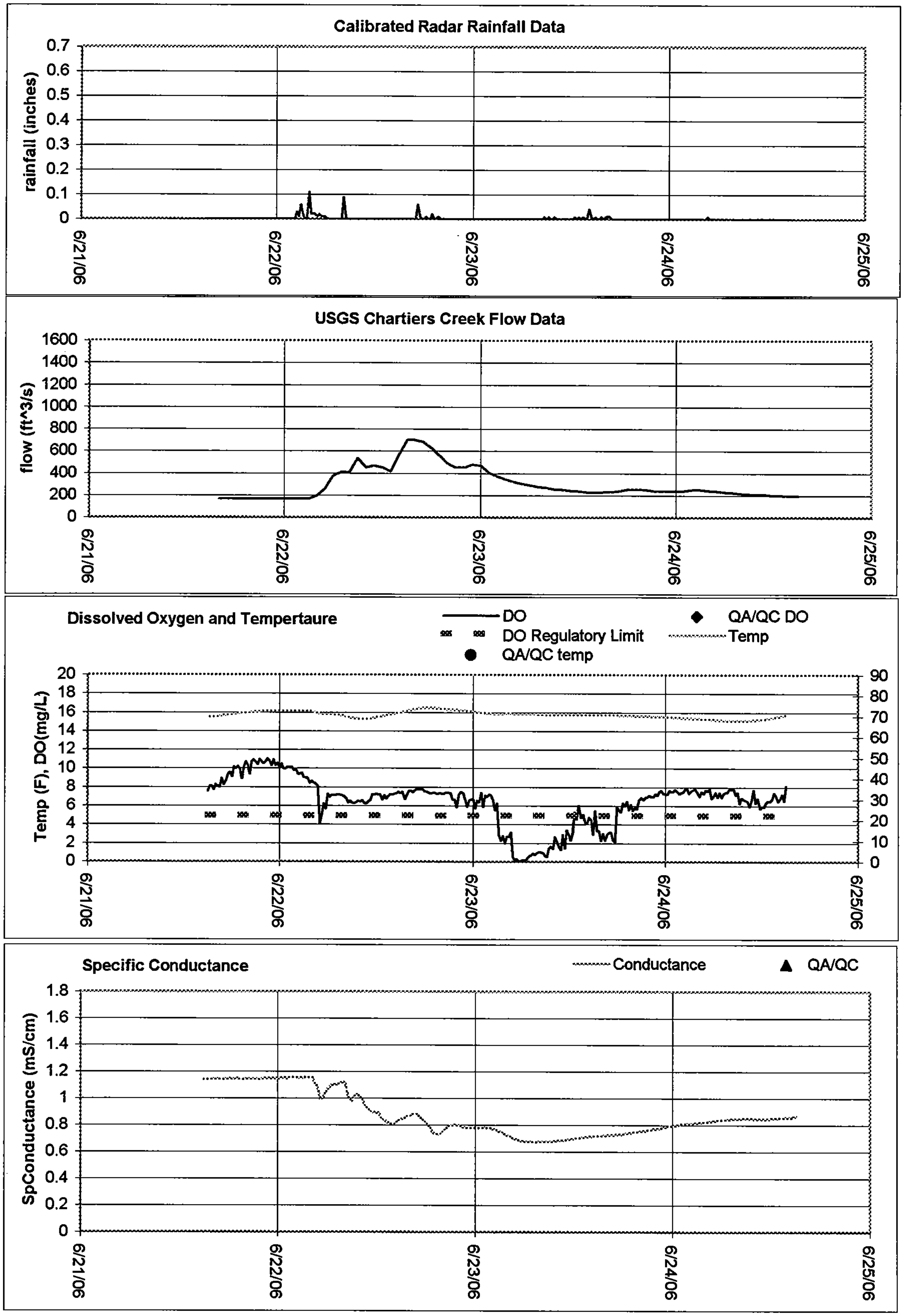


Figure 5-3
Example Storm Graph Chartiers Creek
CC-SW-2
(Probable CSO)

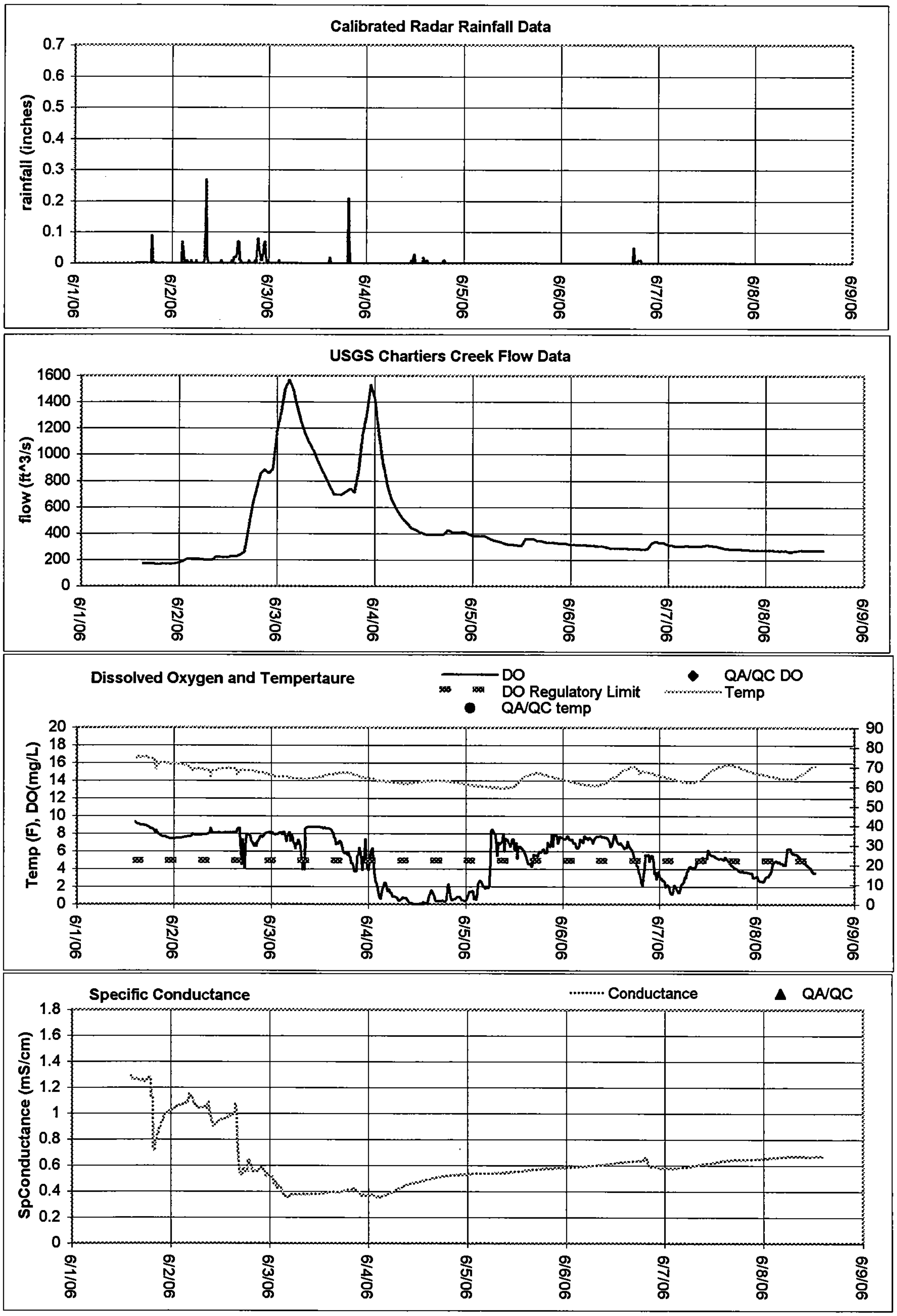


Figure 5-4
Example Storm Graph Nine Mile Run
NM-SW-1

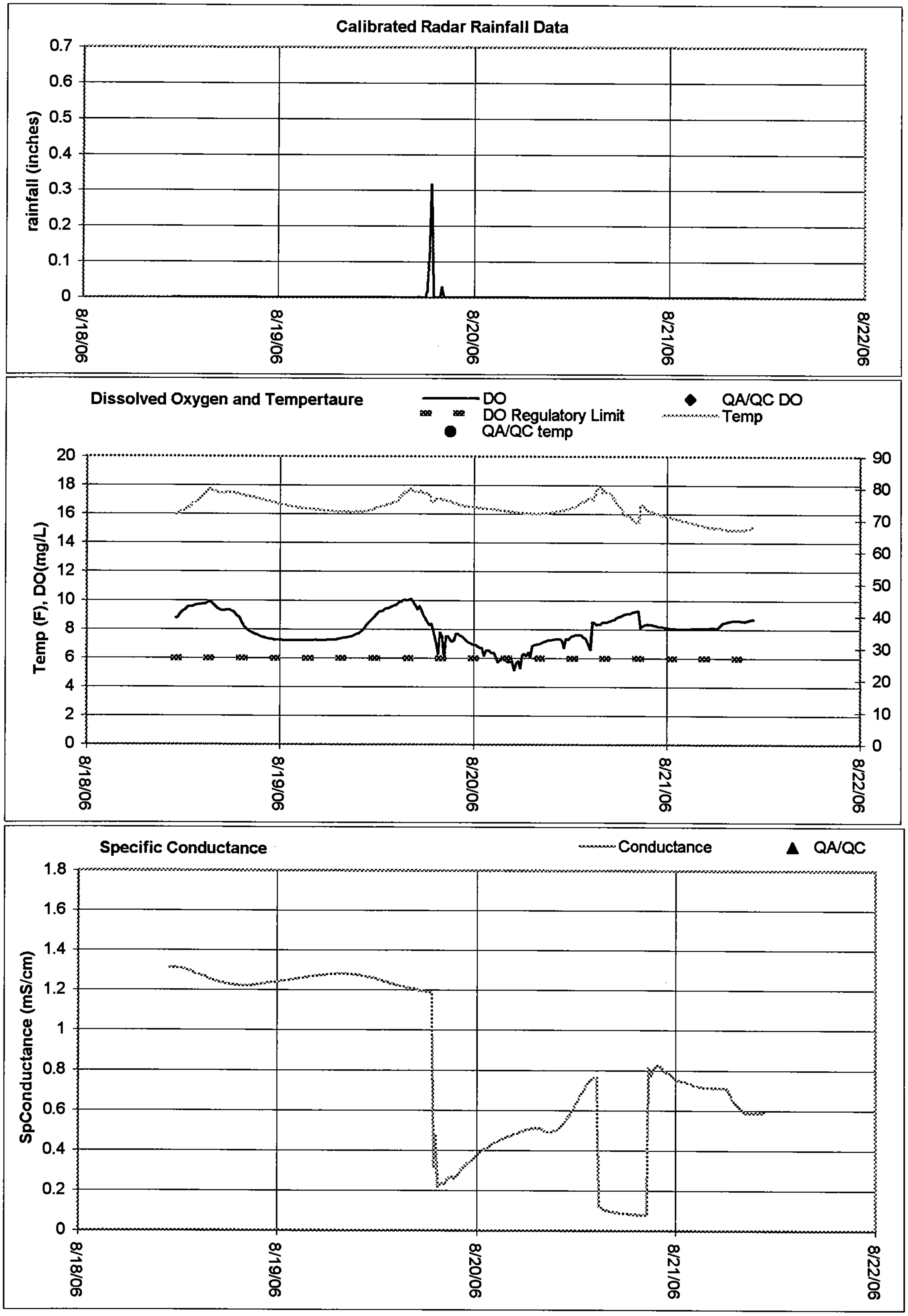


Figure 5-5
Example Storm Graph Saw Mill Run
SM-SW-1
(Probable CSO)

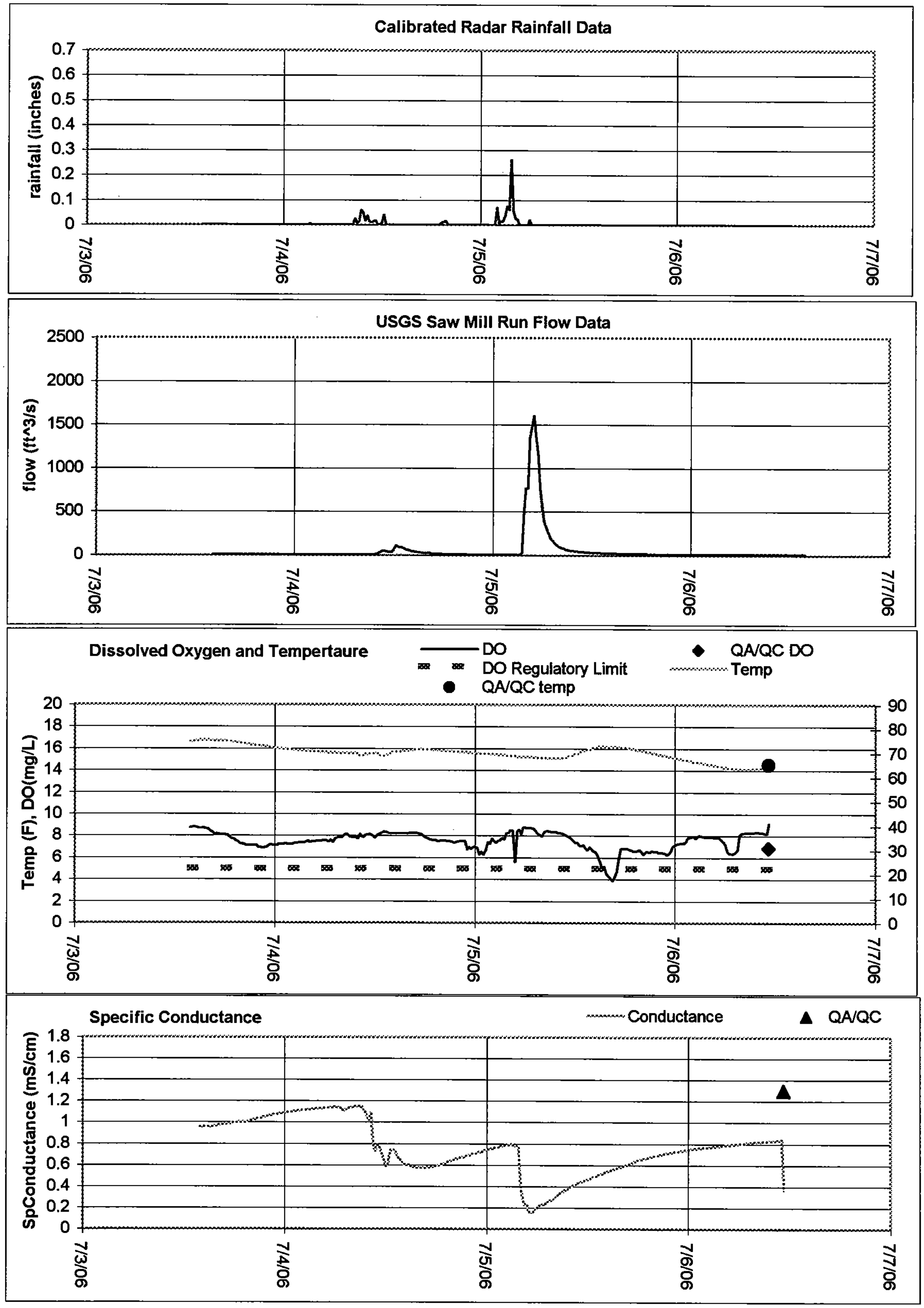


Figure 5-6
Example Storm Graph Saw Mill Run
SM-SW-2
(Probable CSO)

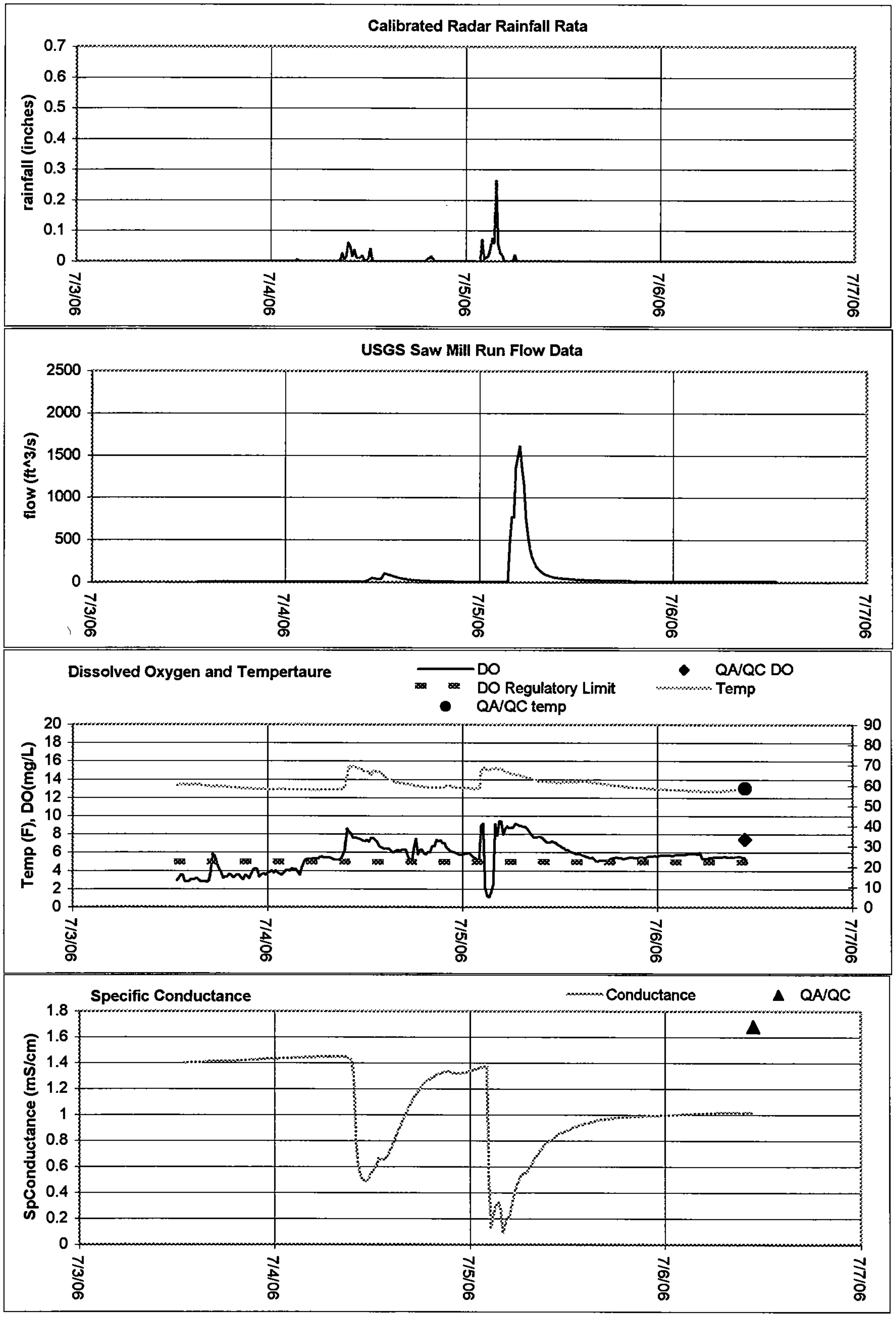
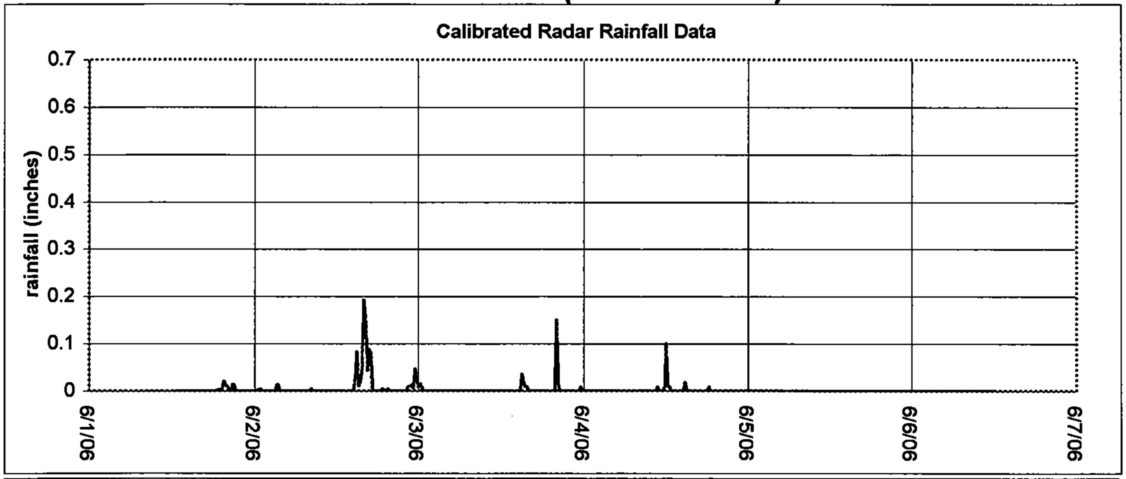
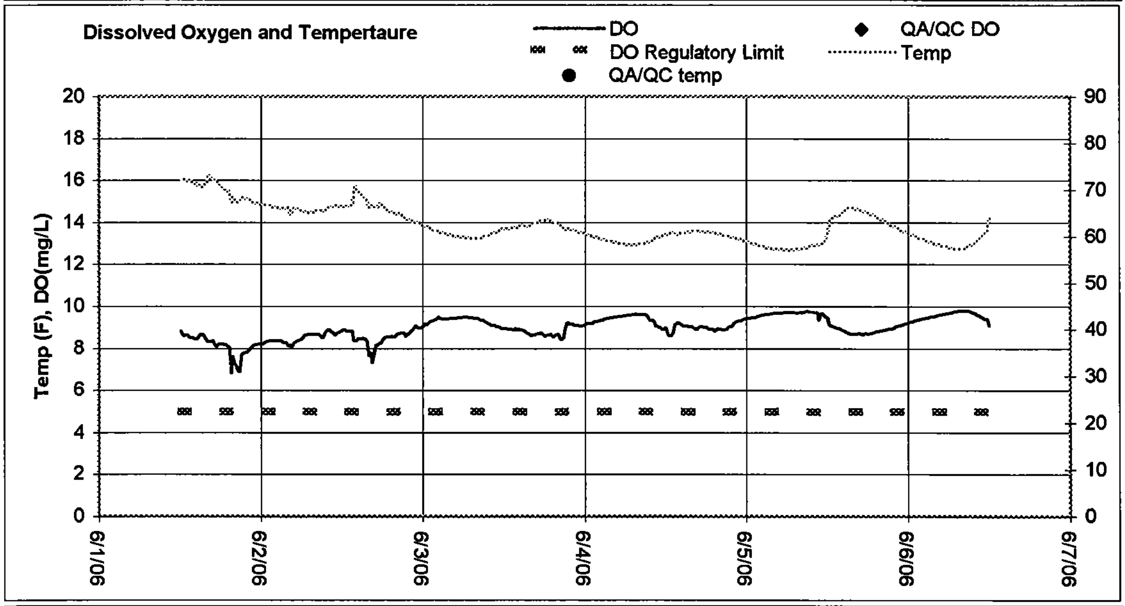
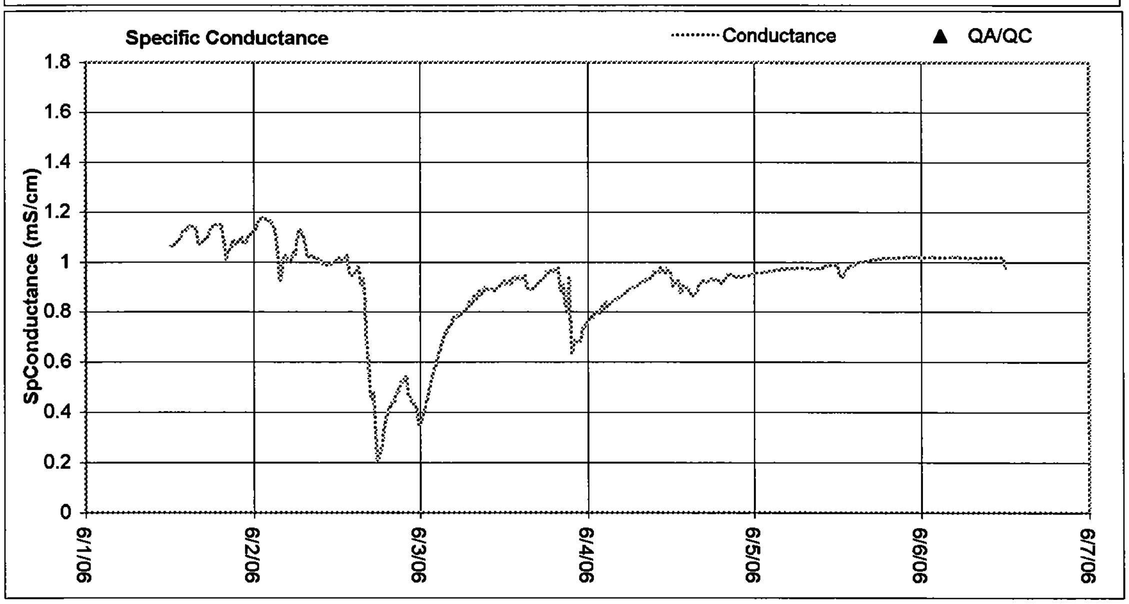


Figure 5-7
Example Storm Graph Streets Run
SR-SW-1
(Probable CSO)







6.0 FINDINGS

Review of the data presented in this memorandum provides the following findings:

Becks Run (BR-SW-1). No DO depressions below regulatory limits occurred during the monitoring period. In general, dissolved oxygen concentrations, temperature and pH were within specific water quality criteria (see Attachment A).

Chartiers Creek (CC-SW-1). DO depressions below regulatory limits occurred at this location in June, July, and August during storm events. Some severe depressions with DO concentrations close to zero were observed in the data set. This indicates wet weather impacts on the receiving water quality. One likely source would be CSO and SSO discharges during the storm events.

The lag time for the occurrence of DO depressions were not consistent. The longest lag time (from stream flow response to occurrence of low DO) was up to 3 days for the storm that occurred on June 2 & 3. One contributing factor to the lag time is the location of the stream gage (upstream) in relation to the Chartiers Creek (CC-SW-1) sampling point.

Though the location of this monitoring point is downstream of most of PWSA CSOs, there are also numerous CSOs from other municipalities entering the stream between this location and the upstream location. In addition, based on dry weather analysis (significant variations in diurnal variation), these DO depressions may be caused by conditions other than CSOs during the whole monitoring period. DO depressions below regulatory limits occurred during dry weather during July.

Chartiers Creek (CC-SW-2): DO depressions below regulatory limits occurred at this location in June, July, August and September during storm events. This monitoring location is upstream of any PWSA CSOs and can be considered as the water quality coming into the PWSA Service Area.

The observation of DO depressions from the data at this location shows that the creek is potentially impacted by wet weather discharges from upstream municipalities. Consequently, any incremental CSO or SSO discharges will only exacerbate the low DO condition.

In addition to the preceding findings, dry weather analysis (significant variations in diurnal variation), show that some dry weather DO depressions occur. DO depressions below regulatory limits occurred during dry weather in July and August. These conditions are not directly attributable to CSO and SSO discharges.

Nine Mile Run (NM-SW-1). DO depressions below regulatory limits occurred in June, July and August during storm events. This location is downstream of most of the CSOs in the stream. There were no DO depressions below regulatory limits during dry weather at this location.

<u>Saw Mill Run (SM-SW-1):</u> DO depressions below regulatory limits occurred in June, July and August during storm events. This location is downstream of a significant portion of the PWSA CSOs. Based on dry weather analysis (wide swings in diurnal variation), these DO depressions may be caused by conditions other than CSOs during the whole monitoring period. DO depressions below regulatory limits occurred during dry weather in July.

<u>Saw Mill Run (SM-SW-2):</u> DO depressions below regulatory limits occurred in June and July during storm events at this location. This location is upstream of the PWSA CSOs. Based on dry weather analysis, these DO depressions are most likely not caused by conditions other than CSOs. DO depressions below regulatory limits occurred during dry weather in August. The water quality at this location can be considered as the water quality coming into the PWSA Service Area.

<u>Streets Run:</u> No DO depressions below regulatory limits occurred during the monitoring period.

These findings form the basis for the recommendations outlined in the following section. It should be noted that these findings have been limited to issues that dealt directly with the potential for water quality impacts resulting from CSO or SSO discharges.

7.0 RECOMMENDATIONS

Pollutants typically found in CSOs include floatables, TSS, BOD, metals, bacteria, phosphorus, ammonia, oil & grease, etc. Impacts from these pollutants include DO depletion, public health impacts and impairment of physical characteristics standards that include aesthetics. CSO treatment approaches to control these pollutants range from screening and disinfection to storage and treatment alternatives. These approaches depend on knowledge of the existing impacts in-stream in order to develop the most cost-effective treatment alternative. The purpose of this Water Quality Assessment was to determine if there are potential violations of the DO standard during wet weather.

In preparing the M&S Plan, the project concluded that based on the existing data and general knowledge (experience) with large rivers, the three main rivers – Allegheny, Monongahela and Ohio – would not exhibit wet weather DO depressions. Consequently, CSO control could be limited to facilities that control floatables and bacteria. For the tributary creeks, this assumption could not be easily made, hence the Water Quality Assessment program.

Section 93.6b (general water quality criteria) includes control of substances such as "...floating materials, oil, grease, scum...." This part of the standards can be addressed through floatables control.

Based on the water quality analysis presented in this technical memorandum, recommendations can be made for what types of CSO control should be considered or do not need to be considered for each receiving stream during the alternatives analysis for the LTCP. CSO controls that should be considered for each receiving stream are presented in Table 7-1. These recommendations form the starting point in developing the CSO control alternatives that will be evaluated for PWSA's CSOs.

Table 7-1
Recommended CSO Controls for Receiving Streams

Receiving Water	Recommended Applicable CSO Controls		
	Controls for Floatables	Controls for Bacteria	Storage to Minimize DO Depression
Becks Run	X	X	
Chartiers Creek	X	X	X
Nine Mile Run	X	X	X
Saw Mill Run	X	X	X
Streets Run	X	X	
Allegheny River	X	X	
Ohio River	X	X	
Monongahela River	X	X	

ATTACHMENTS

ATTACHMENT A
CHAPTER 93 WATER QUALITY CRITERIA

§ 93.6. General water quality criteria

(a) Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life.

(b) In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances that produce color, tastes, odors, turbidity or settle to form deposits.

Authority

The provisions of this § 93.6 amended under sections 5(b)(1) and 402 of The Clean Streams Law (35 P. S. § § 691.5(b)(1) and 691.402); and section 1920-A of The Administrative Code of 1929 (71 P. S. § 510-20).

Source

The provisions of this § 93.6 amended March 10, 1989, effective March 11, 1989, 19 Pa.B. 968; amended November 17, 2000, effective November 18, 2000, 30 Pa.B. 6059; amended February 11, 2005, effective February 12, 2005, 35 Pa.B. 1197. Immediately preceding text appears at serial page (272025).

Notes of Decisions

Denial of an application for a mine drainage permit cannot be based solely on the ground that the watershed has been designated a conservation area, but must be reviewed on the basis of whether its proposed operation would discharge an effluent which would result in the degradation of the water quality of a stream in terms of its protected uses designated under this section. *Doraville Enterprises v. Commonwealth*, 73 Pa. D. & C.2d 635, 645, 646 (1975)

The water quality criteria do not preclude the allowance of a reasonable mixing zone if there is no significant effect on the ambient temperature of the stream outside the mixing zone. *In re West Penn Power Co.*, 74 Pa. D. & C.2d 627, 649 (1975).

Cross References

This section cited in 25 Pa. Code § 71.64 (relating to small flow treatment facilities); and 25 Pa. Code § 96.3 (relating to water quality protection requirements).

§ 93.7. Specific water quality criteria.

(a) Table 3 displays specific water quality criteria and associated critical uses. The criteria associated with the Statewide water uses listed in § 93.4, Table 2 apply to all surface waters, unless a specific exception is indicated in § § 93.9a—93.9z. Other specific water quality criteria apply to surface waters as specified in § § 93.9a—93.9z. All applicable criteria shall be applied in accordance with this chapter, Chapter 96 (relating to water quality standards implementation) and other applicable State and Federal laws and regulations.

TABLE 3

Parameter	*Symbol*	*Criteria*	*Critical Use**
Alkalinity	Alk	Minimum 20 mg/l as CaCO3, except where natural conditions are less. Where discharges are to waters with 20 mg/l or less alkalinity, the discharge should not further reduce the alkalinity of the receiving waters.	CWF, WWF, TSF, MF
Ammonia Nitrogen	Am	The maximum total ammonia nitrogen concentration at all times shall be the numerical value given by: un-ionized ammonia nitrogen (NH_3-N) x ($\log^{-1}[pK_T$-pH] + 1), where: un-ionized ammonia nitrogen = 0.12 x f(T)/f(pH) $f(pH) = 1 + 10^{1.03(7.32-pH)}$ f(T) = 1, T >= 10°C $f(T) = 1 + 10^{(9.73-pH)}$, T < 10°C $1 + 10^{(pK_T-pH)}$ and pK_T = , the dissociation 0.090 + constant for ammonia in water. 2730 (T + 273.2) [] The average total ammonia nitrogen concentration over any 30 consecutive days shall be less than or	1

		equal to the numerical value given by: un-ionized ammonia nitrogen (NH_3-N) x ($\log^{-1}[pK_T - pH] + 1$), where: un-ionized ammonia nitrogen = 0.025 x f(T)/f(pH) $f(pH) = 1, pH >= 7.7$ $f(pH) = 10^{0.74(7.7-pH)}, pH < 7.7$ $f(T) = 1, T >= 10°C$ $f(T) = 1 + 10^{(9.73-pH)}, T < 10°C$ $1 + 10^{(pK_T-pH)}$ The pH and temperature used to derive the appropriate ammonia criteria shall be determined by one of the following methods: 1) Instream measurements, representative of median pH and temperature—July through September. 2) Estimates of median pH and temperature—July through September—based upon available data or values determined by the Department. For purposes of calculating effluent limitations based on this value the accepted design stream flow shall be the actual or estimated lowest 30-consecutive-day average flow that occurs once in 10 years.	
Bacteria	Bac_1	(Fecal coliforms/ 100 ml)—During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10% of the total samples taken during a 30-day period may exceed 400 per 100 ml. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 per 100 milliliters (ml) based on a minimum of five consecutive samples collected on different days during a 30-day period.	WC
	Bac_2	(Coliforms/100 ml)—Maximum of 5,000/100 ml as a monthly average value, no more than this number in more than 20 of the samples collected during a month, nor more than 20,000/100 ml in more than 5% of the samples.	PWS
Chloride	Ch	Maximum 250 mg/l.	PWS
Color	Col	Maximum 75 units on the platinum-cobalt scale; no other colors perceptible to the human eye.	PWS
Dissolved Oxygen		The following specific dissolved oxygen criteria recognize the natural process of stratification in lakes, ponds and impoundments. These criteria apply	

		to flowing waters and to the epilimnion of a naturally stratified lake, pond or impoundment. The hypolimnion in a naturally stratified lake, pond or impoundment is protected by the narrative water quality criteria in § 93.6 (relating to general water quality criteria). For nonstratified lakes, ponds or impoundments, the dissolved oxygen criteria apply throughout the lake, pond or impoundment to protect the critical uses.	
	DO_1	For flowing waters, minimum daily average 6.0 mg/l; minimum 5.0 mg/l. For lakes, ponds and impoundments, minimum 5.0 mg/l.	CWF HQ-WWF HQ-TSF
	DO_2	Minimum daily average 5.0 mg/l; minimum 4.0 mg/l.	WWF
	DO_3	For the period February 1 to July 31 of any year, minimum daily average 6.0 mg/l; minimum 5.0 mg/l. For the remainder of the year, minimum daily average 5.0 mg/l; minimum 4.0 mg/l.	TSF
	DO_4	Minimum 7.0 mg/l.	HQ-CWF
Fluoride	F	Daily average 2.0 mg/l.	PWS
Iron	Fe_1	30-day average 1.5 mg/l as total recoverable.	CWF, WWF, TSF, MF
	Fe_2	Maximum 0.3 mg/l as dissolved.	PWS
Manganese	Mn	Maximum 1.0 mg/l, as total recoverable.	PWS
Nitrite plus Nitrate	N	Maximum 10 mg/l as nitrogen.	PWS
Osmotic Pressure	OP	Maximum 50 milliosmoles per kilogram.	CWF, WWF, TSF, MF
pH	pH	From 6.0 to 9.0 inclusive.	CWF, WWF, TSF, MF
Phenolics (except § 307(a)(1) (33 U.S.C.A. § 1317(a)(1)), Priority Pollutants)	Phen	Maximum 0.005 mg/l.	PWS
Sulfate	Sul	Maximum 250 mg/l.	PWS
Temperature		Maximum temperatures in the receiving water body	See the

resulting from heated waste sources regulated under Chapters 92, 96 and other sources where temperature limits are necessary to protect designated and existing uses. Additionally, these wastes may not result in a change by more than 2°F during a 1-hour period.

following table.

SYMBOL: CRITICAL USE: PERIOD	*$TEMP_1$ CWF*	*$TEMP_2$ WWF TEMPERATURE °F*	*$TEMP_3$ TSF*
January 1-31	38	40	40
February 1-29	38	40	40
March 1-31	42	46	46
April 1-15	48	52	52
April 16-30	52	58	58
May 1-15	54	64	64
May 16-31	58	72	68
June 1-15	60	80	70
June 16-30	64	84	72
July 1-31	66	87	74
August 1-15	66	87	80
August 16-30	66	87	87
September 1-15	64	84	84
September 16-30	60	78	78
October 1-15	54	72	72
October 16-31	50	66	66
November 1-15	46	58	58
November 16-30	42	50	50
December 1-31	40	42	42

Parameter	*Symbol*	*Criteria*	*Critical Use**
Total Dissolved Solids	TDS	500 mg/l as a monthly average value; maximum 750 mg/l.	PWS

Total Residual Chlorine	TRC	Four-day average 0.011 mg/l; 1-hour average 0.019 mg/l.	CWF, WWF, TSF, MF

*Critical use: The most sensitive designated or existing use the criteria are designed to protect.

(b) Table 4 contains specific water quality criteria that apply to the water uses to be protected. When the symbols listed in Table 4 appear in the Water Uses Protected column in § 93.9, they have the meaning listed in the second column of Table 4. Exceptions to these standardized groupings will be indicated on a stream-by-stream or segment-by-segment basis by the words ''Add'' or ''Delete'' followed by the appropriate symbols described elsewhere in this chapter.

TABLE 4

Symbol	*Water Uses Protected*	*Specific Criteria*
WWF	Statewide list	DO_2 and $Temp_2$
CWF	Statewide list plus Cold Water Fish	DO_1 and $Temp_1$
TSF	Statewide list plus Trout Stocking	DO_3 and $Temp_3$
HQ-WWF	Statewide list plus High Quality Waters	DO_1 and $Temp_2$
HQ-CWF	Statewide list plus High Quality Waters and Cold Water Fish	DO_4 and $Temp_1$
HQ-TSF	Statewide list plus High Quality Waters and Trout Stocking	DO_1 and $Temp_3$
EV	Statewide list plus Exceptional Value Waters	Existing quality

(c) The list of specific water quality criteria does not include all possible substances that could cause pollution. For substances not listed, the general criterion that these substances may not be inimical or injurious to the existing or designated water uses applies. The Department will develop a criterion for any substance not listed in Table 3 that is determined to be inimical or injurious to existing or designated water uses using the best available scientific information, as determined by the Department.

(d) If the Department determines that natural quality of a surface water segment is of lower quality than the applicable aquatic life criteria in Table 3, the natural quality shall constitute the aquatic life criteria for that segment. All draft natural quality determinations shall be published in the *Pennsylvania Bulletin* and be subject to a minimum 30-day comment period. The Department will maintain a publicly available list of surface waters and parameters where this subsection applies, and shall, from time to time, submit appropriate amendments to § § 93.9a—93.9z.

Authority

The provisions of this § 93.7 amended under sections 5(b)(1) and 402 of The Clean Streams Law (35 P. S. § § 691.5(b)(1) and 691.402); and section 1920-A of The Administrative Code of 1929 (71 P. S. § 510-20).

Source

The provisions of this § 93.7 amended through March 8, 1985, effective February 16, 1985, 15 Pa.B. 907; amended March 10, 1989, effective March 11, 1989, 19 Pa.B. 968; amended February 11, 1994, effective February 12, 1994, 24 Pa.B. 832; amended April 3, 1998, effective November 4, 1995, 28 Pa.B. 1633; amended July 16, 1999, effective July 17, 1999, 29 Pa.B. 3720; amended November 17, 2000, effective November 18, 2000, 30 Pa.B. 6059; amended February 11, 2005, effective February 12, 2005, 35 Pa.B. 1197. Immediately preceding text appears at serial pages (272026) to (272030) and (294441).

Notes of Decisions

The Department of Environmental Resources is not required to consider the economic consequences to a discharger in establishing water-quality based effluent limitations in a National Pollutant Discharge Elimination System (NPDES) Permit. *Mathies Coal Company v. Department of Environmental Resources*, 559 A.2d 506 (Pa. 1989).

The water quality standards in 25 Pa. Code § 93.7 are to be considered only as one of the major factors in developing discharge limitations, and neither these standards nor effluent limitations based on them in case-by-case DER determinations require a presumption of validity. *Lucas v. Department of Environmental Resources*, 420 A.2d 1 (Pa. Cmwlth. 1980).

Cross References

This section cited in 25 Pa. Code § 93.4b (relating to qualifying as High Quality or Exceptional Value Waters); 25 Pa. Code § 93.8 (relating to development of site-specific water quality criteria for the protection of aquatic life); and 25 Pa. Code § 96.3 (relating to water quality protection requirements).

ATTACHMENT B
EQUIPMENT SPECIFICATIONS

YSI

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- User-upgradable software from YSI's website
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- Three-year warranty

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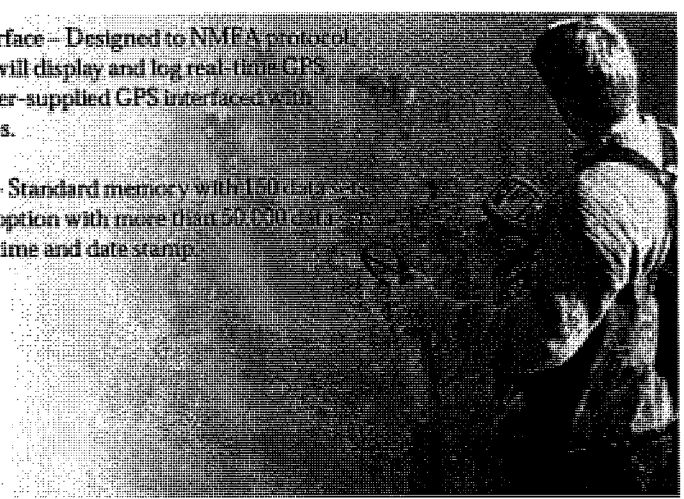
- Optional Barometer – Temperature-compensated barometer readings are displayed and can be used in dissolved oxygen calibration. Measurements can be logged to memory for tracking changes in barometric pressure.
- Optional GPS Interface – Designed to NMEA protocol, the YSI 650 MDS will display and log real-time GPS readings with a user-supplied GPS interfaced with YSI 6-series sondes.
- Memory Options – Standard memory with 150 data sets or a high memory option with more than 50,000 data sets, both options with time and date stamp.



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YSI 650 MDS Specifications

Temperature:	
Operating:	-10° to 60° C for visible display
Storage:	-20° to 70° C
Waterproof:	IP-67 for both the standard alkaline battery configuration and for the rechargeable battery pack option
Size:	11.9 cm width x 22.9 cm length (4.7 in. x 9 in.)
Weight with batteries:	2.1 lbs. (0.91 kg.)
Display:	VGA; LCD with 320 by 240 pixels with backlight
Connector:	MS-8; meets IP-67 specification
Battery:	Standard 4 alkaline C-cells with detachable battery cover Optional Ni metal hydride battery pack with attached battery cover and 110/220 volt charging system
Communications:	RS-232 to all sondes, for data transfer to PC, and for software updates
GPS:	Y-cable; NMEA 0183
Backlight:	4 LEDs illuminating LCD; user-selectable
Keypad:	20 keys, including instrument on/off, backlight on/off, enter, esc, 10 number/letter entry keys, 2 vertical arrow keys, 2 horizontal arrow keys, period key, and minus key
Warranty:	3-Year

How To Order

650-01	Instrument, standard memory
650-02	Instrument, high memory
650-03	Instrument, standard memory, barometer
650-04	Instrument, high memory, barometer
6113	Rechargeable battery pack kit with 110 volt charger and adapter cable
616	Charger, cigarette lighter
4654	Tripod
614	Ultra clamp, C-clamp mount
5081	Carrying case, hard-sided
5085	Hands-free harness
5065	Form-fitted carrying case
6115	Y-cable for interface with user-supplied GPS system

To order or for more information, contact YSI.

800 897-4151

937 767-7241
Fax 937 767-9353
support@YSI.com

www.YSI.com

YSI Incorporated
1700/1725 Brannum Lane
Yellow Springs, Ohio 45387

YSI Massachusetts
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Fax 508 748-2543

YSI (UK) Limited
44 1252 514 711
Fax 44 1252 511 855

YSI (HK) Limited
852 2891 8154
Fax 852 2834 0034

YSI (Japan) Limited
813 5360 3561
Fax 813 5360 3565

ISO 9001
ISO 14001

CE

Be sure to see the YSI 650 MDS feature page which outlines the advantages and benefits of this new technology at: www.YSI.com/650MDS

Printed in USA on recycled paper.
0500 E11

Y S I Environmental

YSI 600XL and 600XLM Sondes

Measure multiple parameters simultaneously

The YSI 600XL and YSI 600XLM compact sondes measure eleven parameters simultaneously:

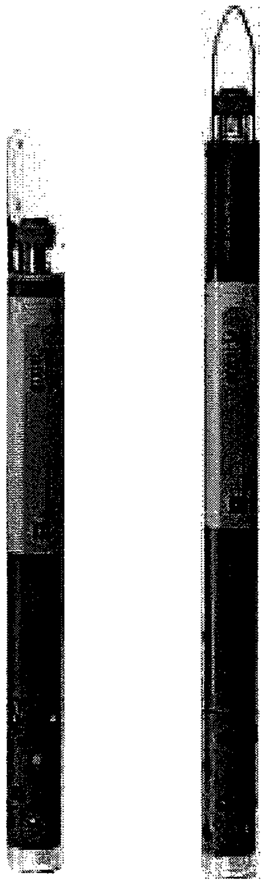
DO (% and mg/L)	ORP
Temperature	Depth or Level
Conductivity	Total Dissolved Solids*
Specific Conductance*	Resistivity*
Salinity*	pH

Connect with Data Collection Platform

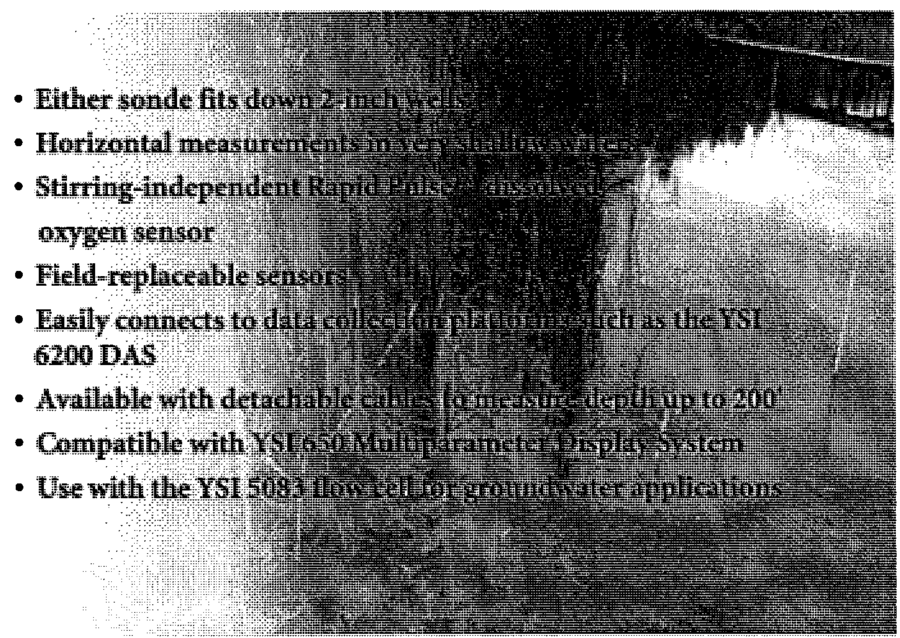
Either sonde can easily connect to the YSI 6200 DAS (Data Acquisition System), or your own data collection platform, via SDI-12 for remote and real-time data acquisition applications.

In addition

The YSI 600XLM is an economical logging system for long-term, *in situ* monitoring and profiling. It will log all parameters at programmable intervals and store 150,000 readings. At one-hour intervals, the instrument will log data for about 75 days utilizing its own power source. The 600XL can also be utilized in the same manner with user-supplied external power.



The YSI 600XL and 600XLM.



Pure Data for a Healthy Planet.™

Compatible with EcoWatch® for Windows® software for data analysis and more!

* Calculated parameters.

www.YSI.com

YSI

Pure Data for a Healthy Planet.™

To order or for more information, contact YSI Environmental.

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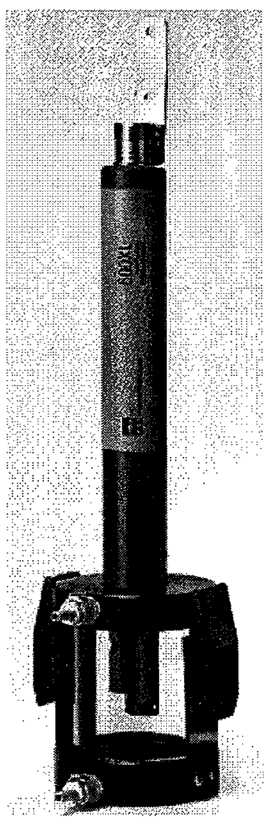
YSI (Qingdao) Limited
86 532 389 6648
Fax 86 532 389 6647
china@YSI.com

ISO 9001
ISO 14001

YSI incorporated
Who's Minding the Planet?™

600XL & 600XLM Sensor Specifications

Dissolved oxygen % saturation	Range	0 to 500%
	Resolution	0.1%
	Accuracy	0 to 200%: ±2% air sat; 200 to 500%: ±6% air sat
Dissolved oxygen mg/L	Range	0 to 50 mg/L
	Resolution	0.01 mg/L
	Accuracy	0 to 20 mg/L: ±0.2 mg/L; 20 to 50 mg/L: ±0.6 mg/L
Conductivity †	Range	0 to 100 mS/cm
	Resolution	0.001 to 0.1 mS/cm (range-dependent)
	Accuracy	±0.5% of reading + 0.001 mS/cm
Temperature	Range	-5 to +45°C
	Resolution	0.01°C
	Accuracy	±0.15°C
pH, includes most low-ionic-strength measurements	Range	0 to 14 units
	Resolution	0.01 unit
	Accuracy	±0.2 unit
Non-vented depth, shallow	Range	0 to 30 feet (0 to 9 m)
	Resolution	0.001 foot (0.001 m)
	Accuracy	±0.06 foot (±0.02 m)
Non-vented depth, medium	Range	0 to 200 feet (0 to 61 m)
	Resolution	0.001 foot (0.001 m)
	Accuracy	±0.4 foot (±0.12 m)
Vented level	Range	0 to 30 feet (0 to 9 m)
	Resolution	0.001 feet (0.0003 m)
	Accuracy	0 to 10 feet (0 to 3 m): ±0.01 feet (0.003 m) 10 to 30 feet (3 to 9 m): ±0.06 feet (0.01 m)
ORP	Range	-999 to +999 mV
	Resolution	0.1 mV
	Accuracy	±20 mV
Salinity	Range	0 to 70 ppt
	Resolution	0.01 ppt
	Accuracy	±1% of reading or 0.1 ppt, whichever is greater



YSI Model 5083 flow cell and 600XL. This is an ideal combination for groundwater applications.

YSI 600XLM sonde

Sampling Medium: Fresh, sea or polluted water
Temperature: -5 to +45°C
Computer interface: RS-232, SDI-12
Logging memory: 384K flash ROM logs ~150,000 readings
Software: PC-compatible, Windows® 95 or higher; 256K RAM minimum. Graphics card recommended.
Size: 1.65" dia., 21.3" long (4.32 x 54.1 cm)
Weight with batteries: 1.5 lbs (0.7 kg)
External power supply: 12 VDC
Internal power supply: 4 AA-alkaline cells capable of logging for 75 days at one-hour intervals at 25°C

YSI 600XL sonde

Sampling Medium: Fresh, sea or polluted water
Temperature: -5 to +45°C
Computer interface: RS-232, SDI-12
Software: PC-compatible, Windows® 95 or higher; 256K RAM minimum. Graphics card recommended.
Size: 1.65" dia., 16" long, 1.3 lbs. (4.19 x 35.6 cm, 0.49 kg)
External power supply: 12 VDC

† Report outputs of specific conductance (conductivity corrected to 25° C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed 1989).

ATTACHMENT C
RAINFALL EVENT SUMMARY

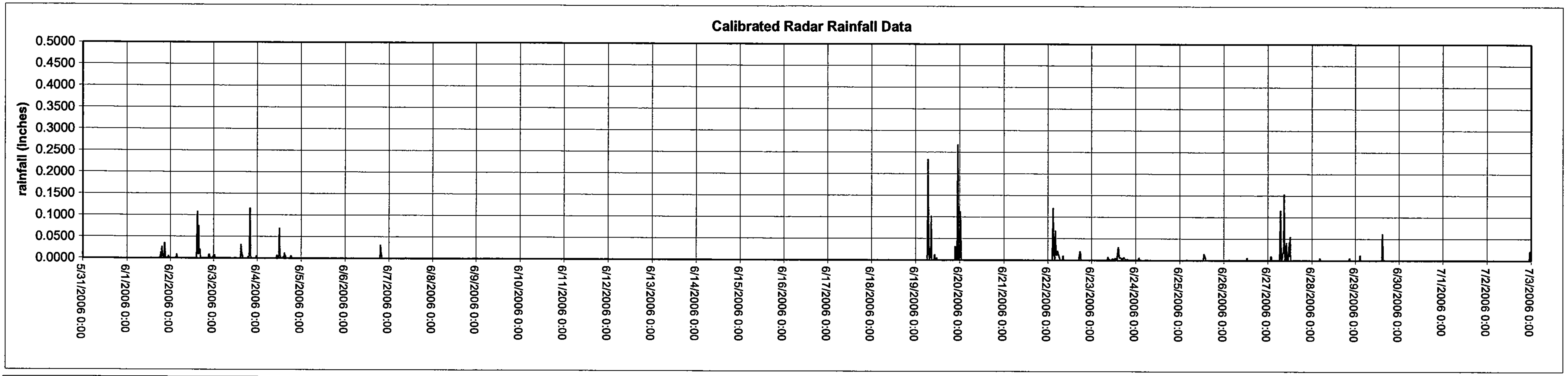
Appendix C
Wet Weather Event Summary

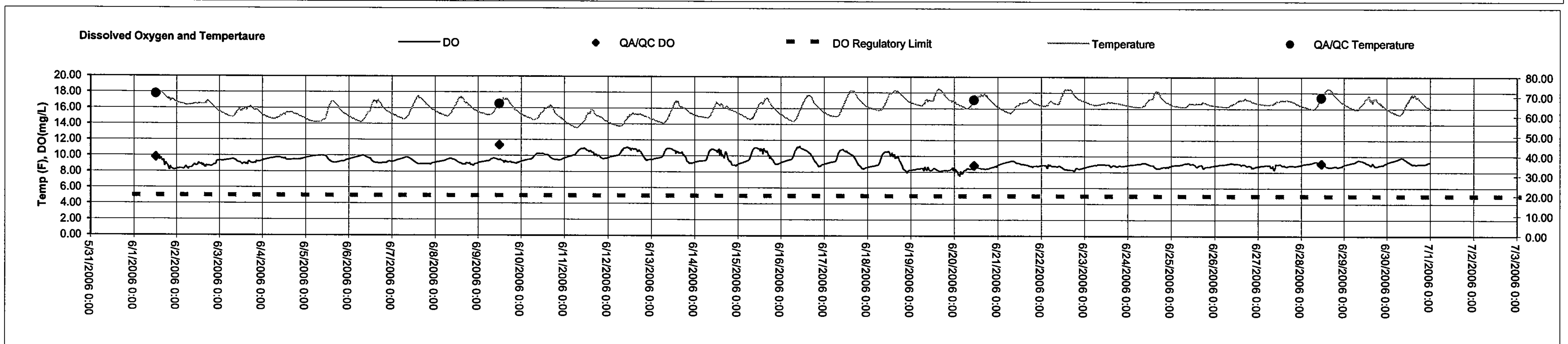
	Storm Event Start Date/Time	BR1 PX-148/PY143 Total Rainfall, in	BR1 PX-148/PY143 Intensity, in/hr	CC1/CC2 PX-139/PY-144 Total Rainfall, in	CC1/CC2 PX-139/PY-144 Intensity, in/hr	NM1 PX-156/PY-139 Total Rainfall, in	NM1 PX-156/PY-139 Intensity, in/hr	SM1/SM2 PX-145/PY-144 Total Rainfall, in	SM1/SM2 PX-145/PY-144 Intensity, in/hr	SR1 PX-150/PY-146 Total Rainfall, in	SR1 PX-150/PY-146 Intensity, in/hr	Approximate Duration, hrs
June	6/1/2006 4:15	0.0880	0.0391	0.0520	0.0231	0.1040	0.0462	0.0960	0.0427	0.1139	0.0506	2.25
	6/1/2006 17:00	0.1580	0.0097	0.0940	0.0058	0.4210	0.0259	0.1280	0.0079	0.1340	0.0082	16.25
	6/2/2006 14:30	0.3550	0.0355	1.1539	0.1154	1.3099	0.1310	0.9029	0.0903	0.9160	0.0916	10
	6/3/2006 14:45	0.2353	0.0196	0.4239	0.0353	0.3000	0.0250	0.1699	0.0142	0.2530	0.0211	12
	6/4/2006 10:30	0.1435	0.0120	0.0731	0.0061	0.1119	0.0093	0.0675	0.0056	0.1719	0.0143	12
	6/6/2006 15:45	0.0583	0.0097	0.2106	0.0351	0.0502	0.0084	0.0660	0.0110	0.0773	0.0129	6
	6/19/2006 6:15	0.5590	0.1016	0.0500	0.0091	0.4570	0.0831	0.4200	0.0764	0.2240	0.0407	5.5
	6/19/2006 21:15	0.6360	0.1817	0.0589	0.0168	0.5250	0.1500	0.4800	0 1371	0.9790	0.2797	3.5
	6/20/2006 3:15					0.0378	0.0189					2
	6/22/2006 2:30	0.4290	0.0686	0.4569	0.0731	0.4890	0.0782	0.6900	0.1104	0.3200	0.0512	6.25
	6/22/2006 17:00	0.0530	0.0073	0.0210	0.0029	0.0540	0.0074	0.0650	0.0090	0.0860	0.0119	7.25
	6/23/2006 8:45	0.1980	0.0165	0.1960	0.0163	0.1840	0.0153	0.2030	0.0169	0.2000	0.0167	12
	6/25/2006 12:45	0.0484	0.0072	0.0114	0.0017	0.1592	0.0236	0.0444	0.0066	0.0407	0.0060	6.75
	6/26/2006 23:15	0.6779	0.0476	0.6990	0.0491	0.9079	0.0637	0.5589	0.0392	0.5980	0.0420	14.25
July	7/2/2006 14:30									0.0018	0.0024	0.75
	7/2/2006 23:15	0.1039	0.0109	0.0991	0.0104	0.0819	0.0086	0.1514	0.0159	0.0851	0.0090	9.5
	7/4/2006 1:15	0.6619	0.0228	1.3938	0.0481	0.7460	0.0257	1.0509	0.0362	1.3020	0.0449	29
	7/11/2006 15:45					0.0083	0.0166					0.5
	7/12/2006 2:30	1.0910	0.0766	0.6100	0.0428	1.1400	0.0800	1.1250	0.0789	1.4797	0.1038	14.25
	7/13/2006 7:30	0.0023	0.0007	0.0100	0.0031	0.0242	0.0074	0.0081	0.0025	0.0005		3.25
	7/21/2006 14:00	0.0016		0.1159	0.0258	0.0072	0.0016	0.0106	0.0024	0.0065	0.0014	4.5
	7/22/2006 5:15	0.2140	0.0156	0.1770	0.0129	0.1800	0.0131	0.1700	0.0124	0.2220	0.0161	13.75
	7/27/2006 13:45	0.1850	0.0218	0.0290	0.0034	0.3160	0.0372	0.1850	0.0218	0.1530	0.0180	8.5
	7/28/2006 6:45	0.3244	0.0721	0.2450	0.0544	0.1491	0.0331	0.4039	0.0898	0.3714	0.0825	4.5
	7/30/2006 7:15	0.0675	0.0540			0.1938	0.1550			0.0013	0.0010	1.25
	7/30/2006 14:45	0.9490	0.1309	1.2569	0.1734	0.4409	0.0608	1.1160	0.1539	1.1420	0.1575	7.25
	7/31/2006 4:45					0.0280	0.0280					1
	7/31/2006 11:45			0.0086	0.0344	0.0054	0.0216					0.25
August	8/1/2006 4:15					0.0054	0.0216					0.25
	8/2/2006 1:45					0.0054	0.0216					0.25
	8/3/2006 18:00	0.0790	0.0075	0.1330	0.0127	0.0720	0.0069	0.0890	0.0085	0.1959	0.0187	10.5
	8/4/2006 5:00									0.0010	0.0040	0.25
	8/14/2006 21:15	0.2580	0.0413	0.1740	0.0278	0.1930	0.0309	0.1569	0.0251	0.5740	0.0918	6.25
	8/19/2006 16:45	0.4690	0.0605	0.4996	0.0645	0.4940	0.0637	0.5180	0.0668	0.2220	0.0286	7.75
	8/24/2006 10:45					0.0257	0.0514					0.5
	8/27/2006 8:45	0.7140	0.0433	0.2449	0.0148	0.6610	0.0401	0.5130	0.0311	0.7442	0.0451	16.5
	8/28/2006 15:30	0.1436	0.0069	0.2005	0.0097	0.1539	0.0074	0.1439	0.0069	0.1600	0.0077	20.75
September	9/1/2006 18:15	1.0289	0.0614	0.56	0.0334	0.625	0.0373	0.9958	0.0595	0.9099	0.0543	16.75
	9/5/2006 1:45	0.212	0.0339	0.196	0.0314	0.189	0.0302	0.207	0.0331	0.211	0.0338	6.25
	9/12/2006 9:15	1.066	0.0463	1.3869	0.0603	1.3248	0.0576	1.159	0.0504	1.064	0.0463	23
	9/13/2006 14:45	0.8099	0.0790	0.4269	0.0416	1.3799	0.1346	0.436	0.0425	1.224	0.1194	10.25
	9/28/2006 7:15	0.3599	0.0369	0.592	0.0607	0.45	0.0462	0.339	0.0348	0.41	0.0421	9.75

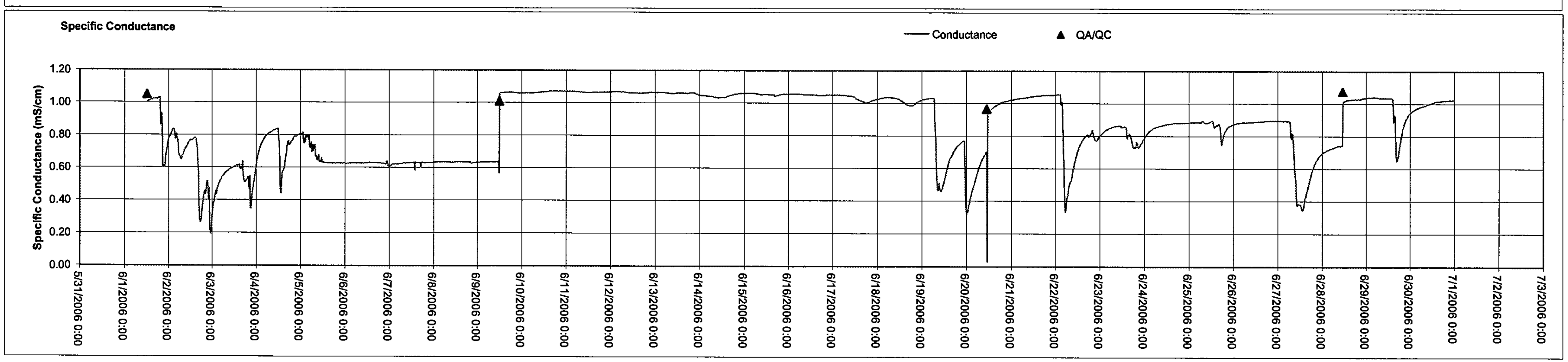
Potential CSO event for storms with more than 0.5 inches of rainfall during one event.
Storm events are separate if there are 6 hours or more between rainfall.

ATTACHMENT D
ADJUSTED DATA GRAPHS

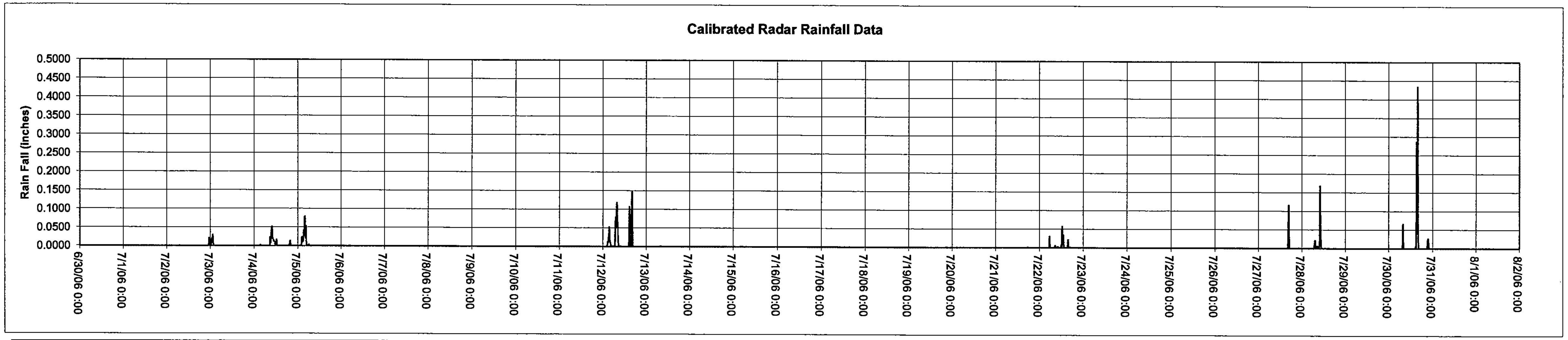
Becks Run 1 - June

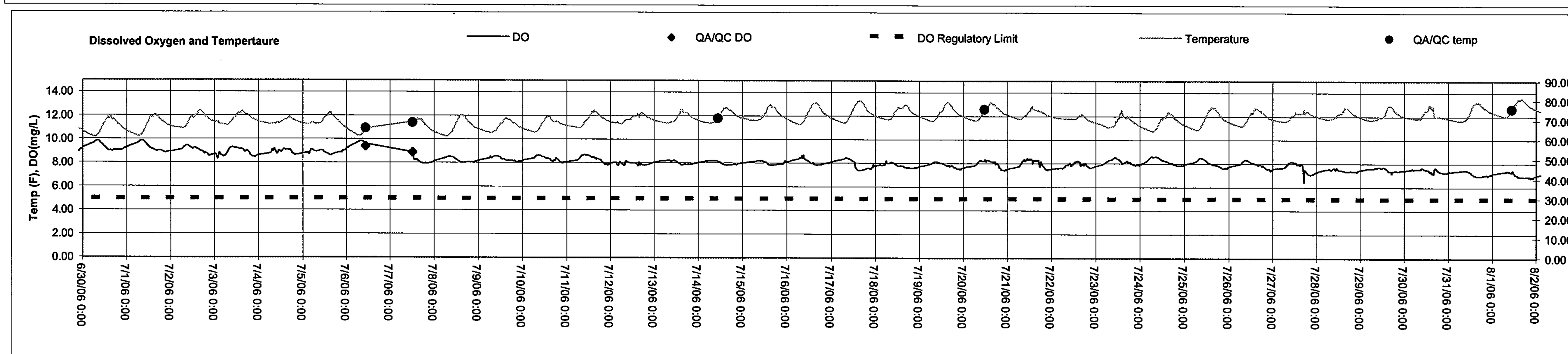


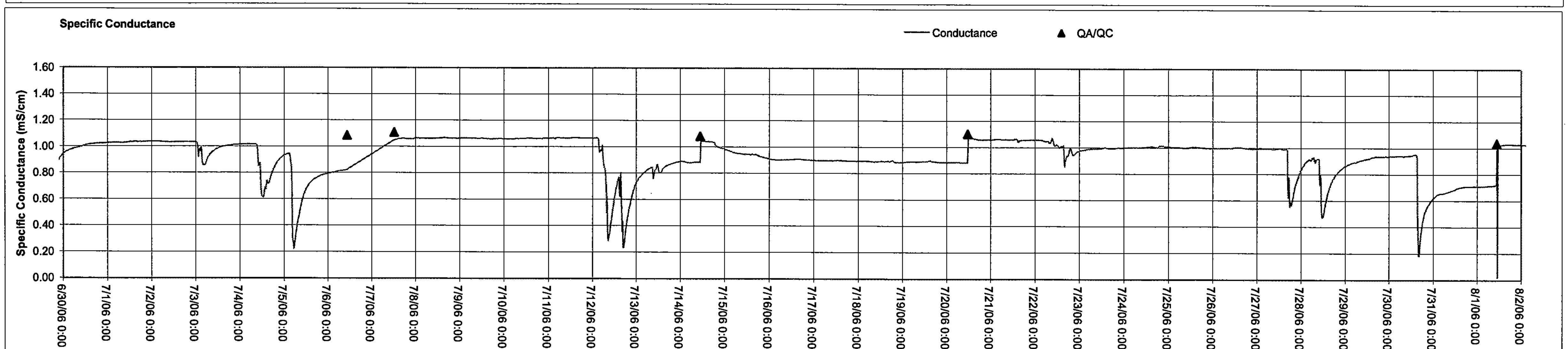




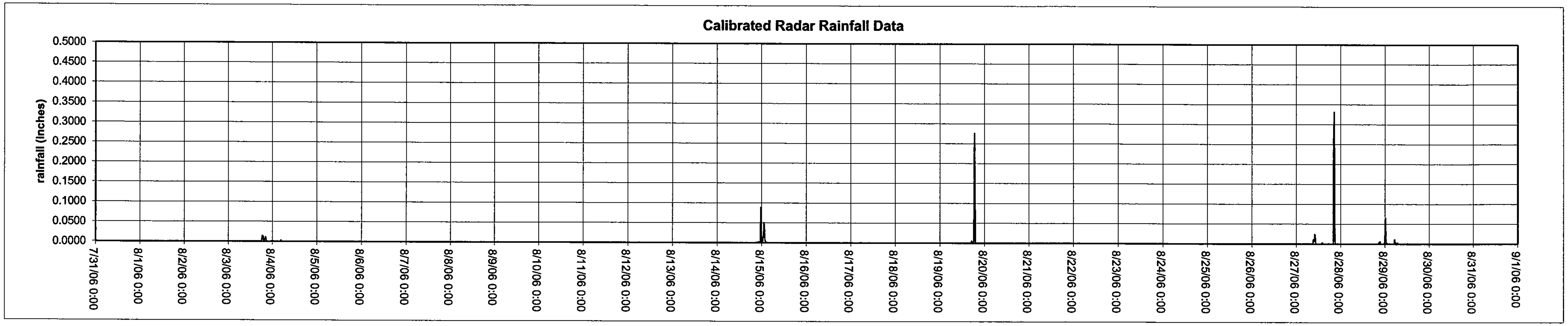
Becks Run 1 - July

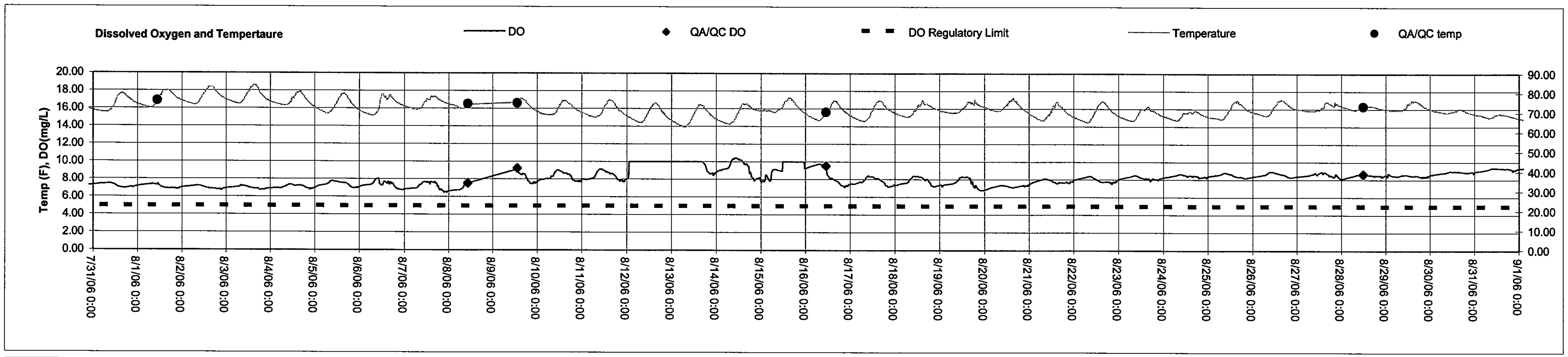


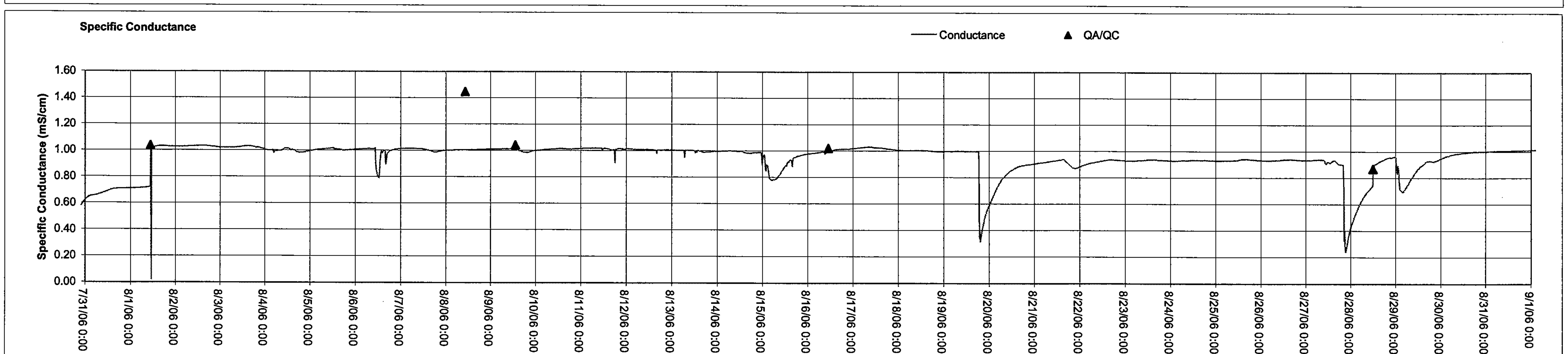




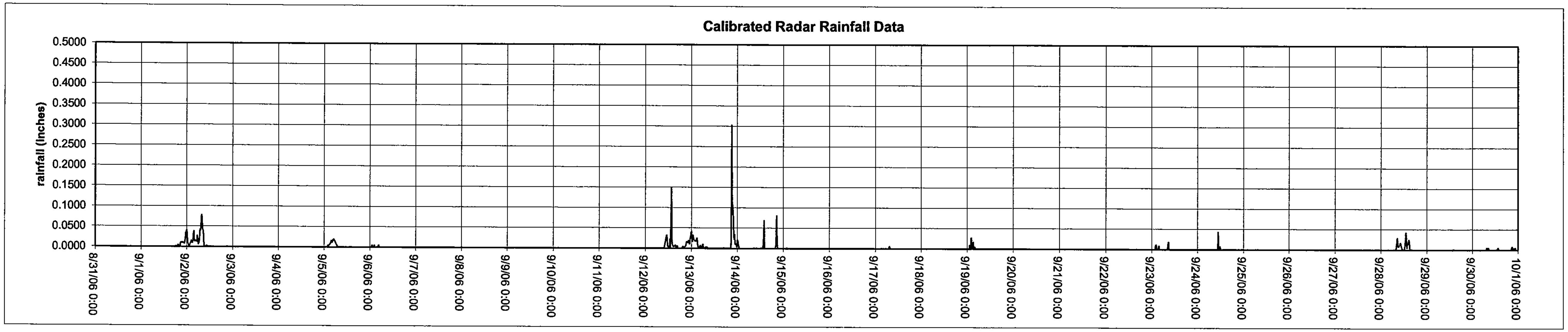
Becks Run 1 - August

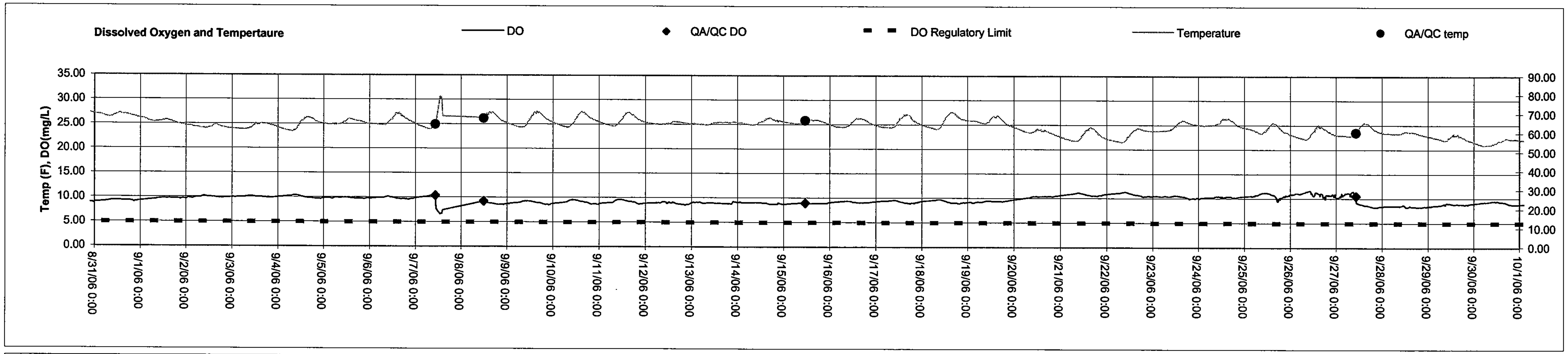


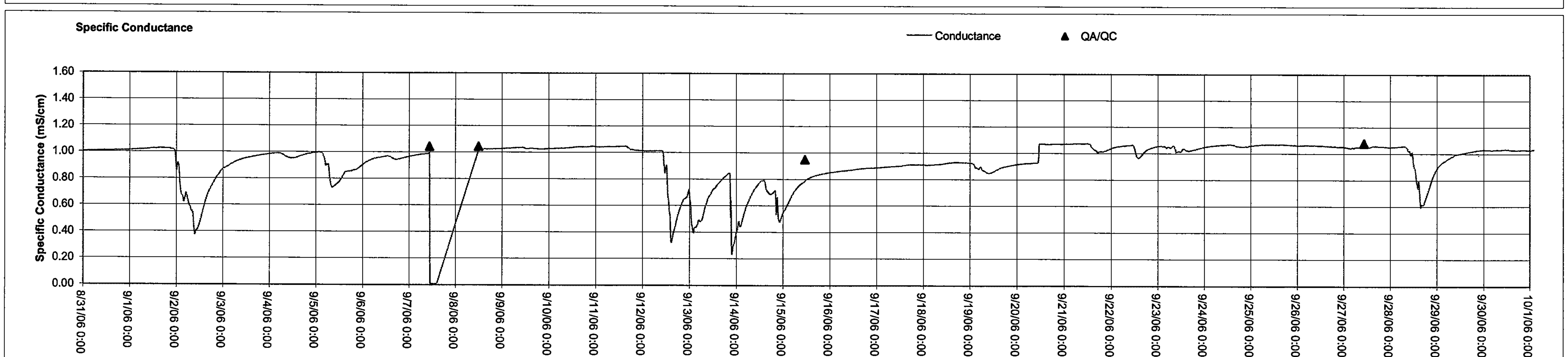




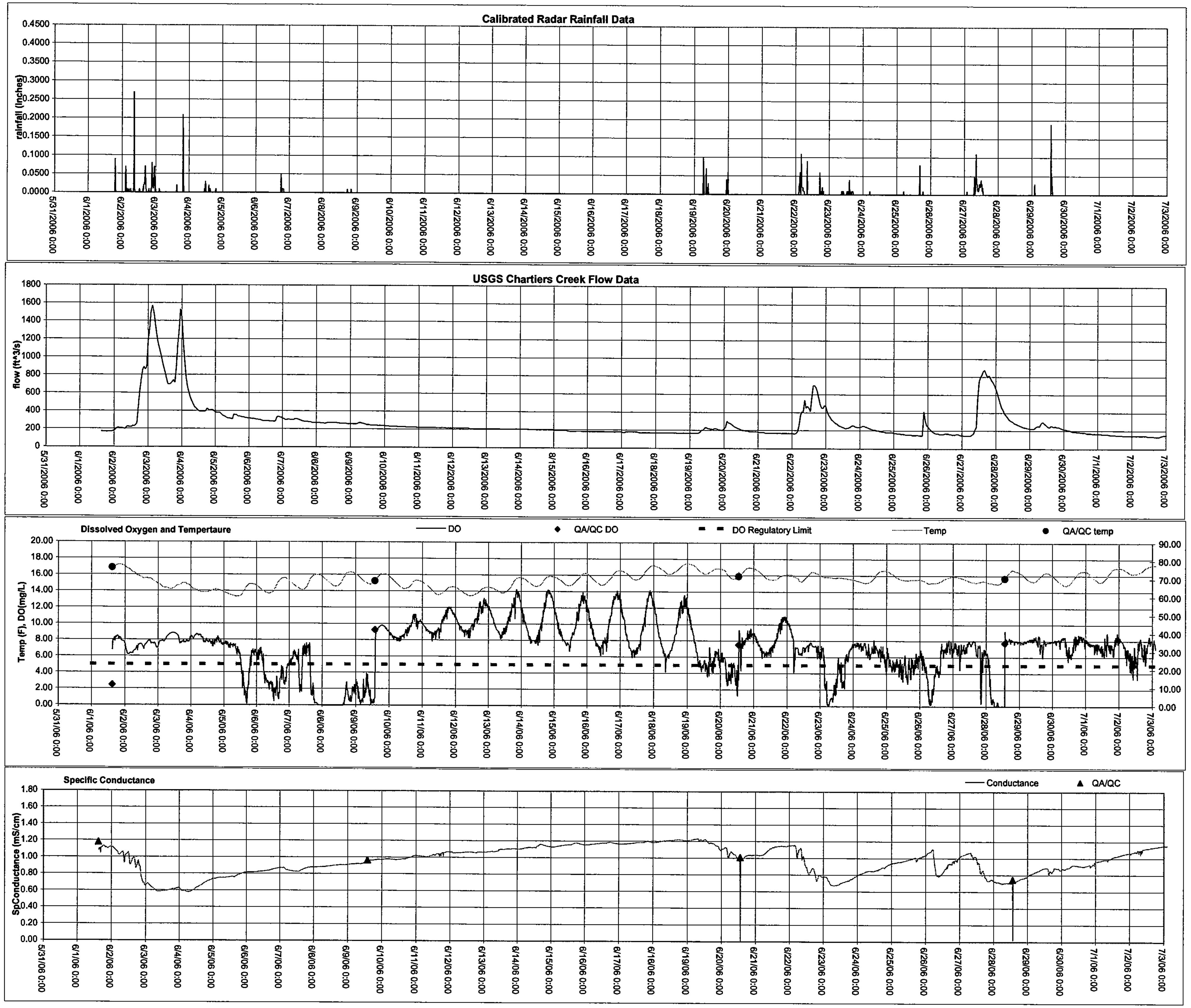
Becks Run 1 - September



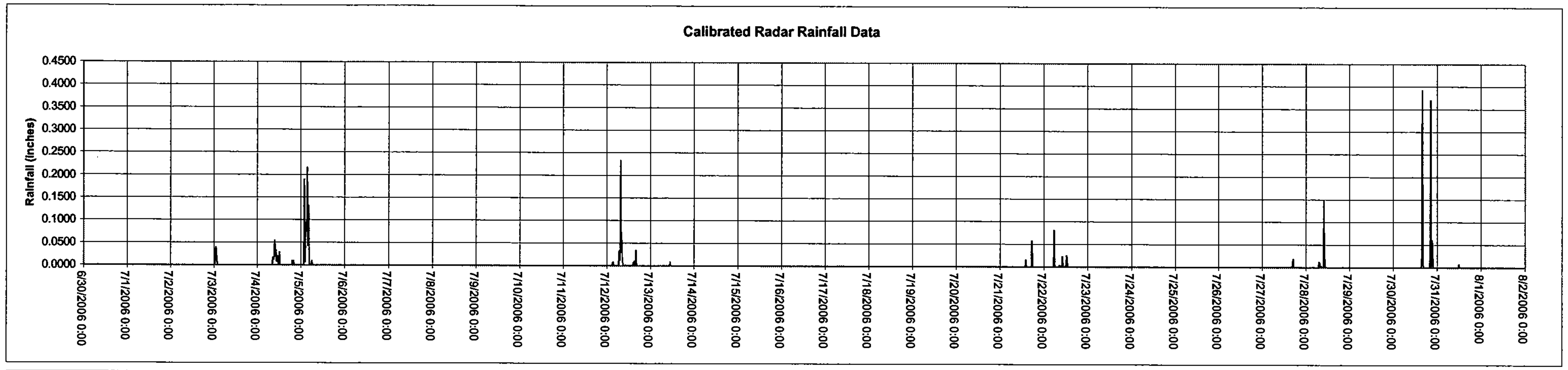


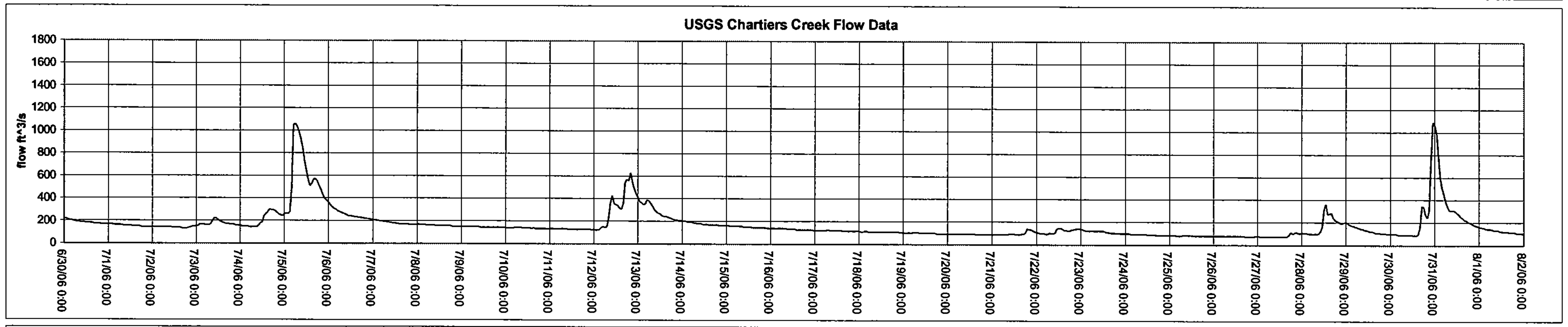


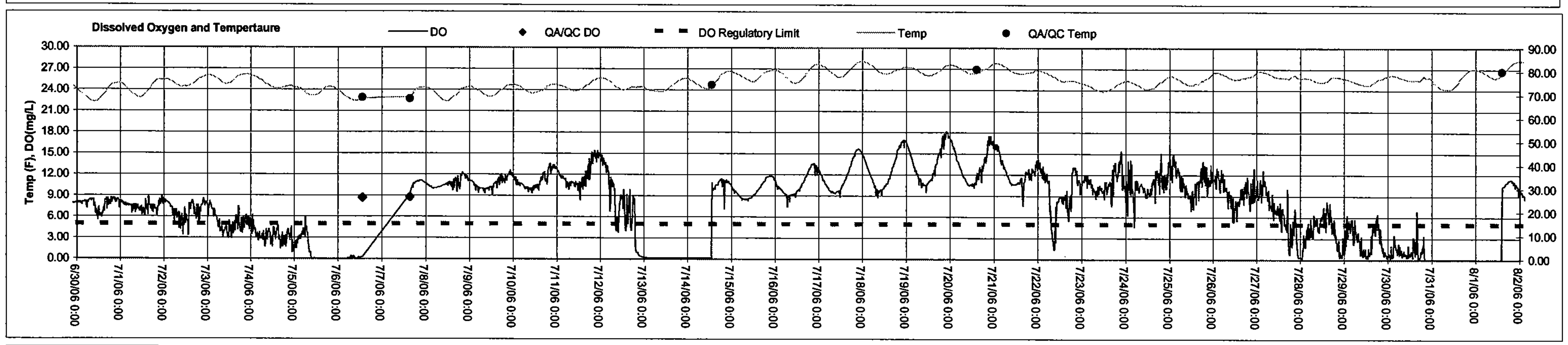
Chartiers Creek 1 - June

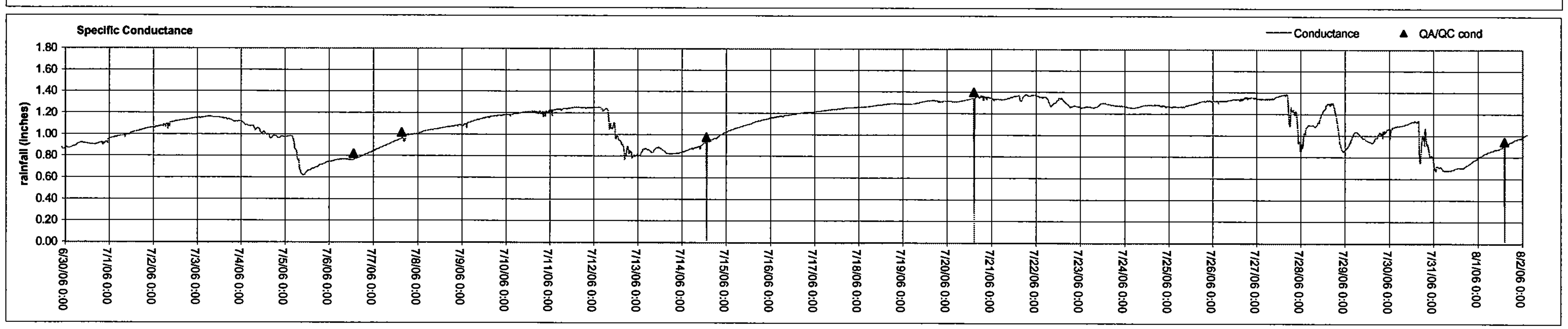


Chartiers Creek 1 - July

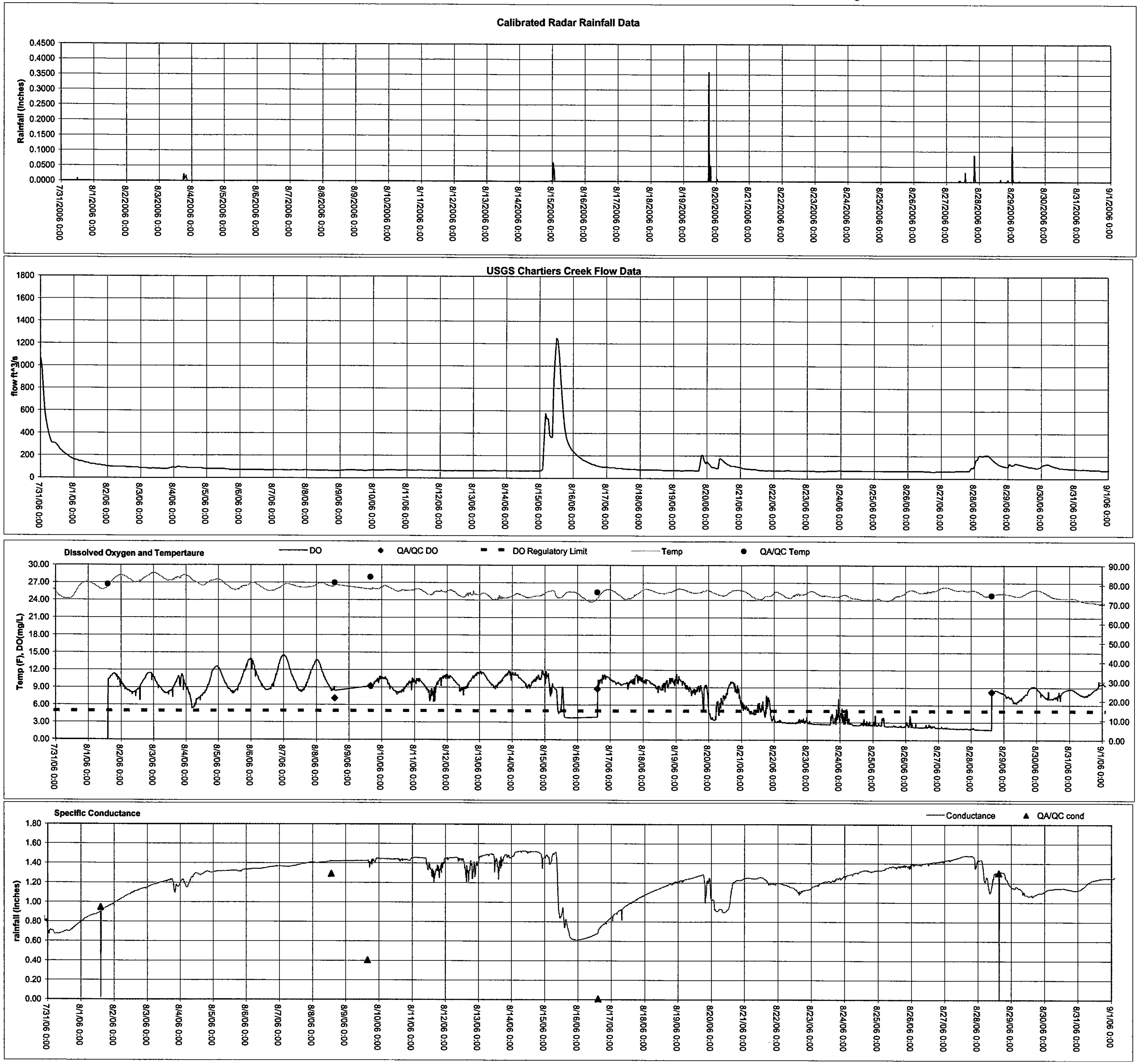




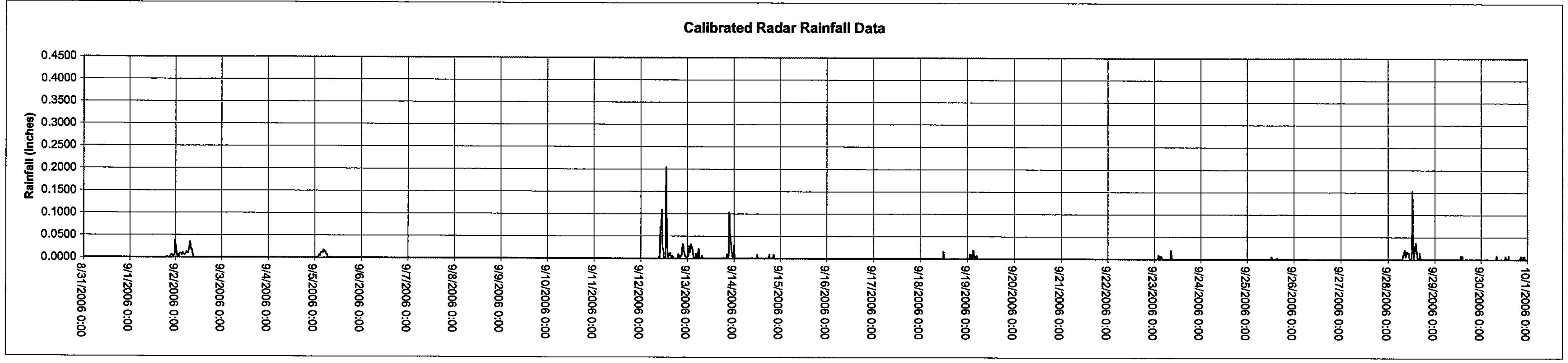


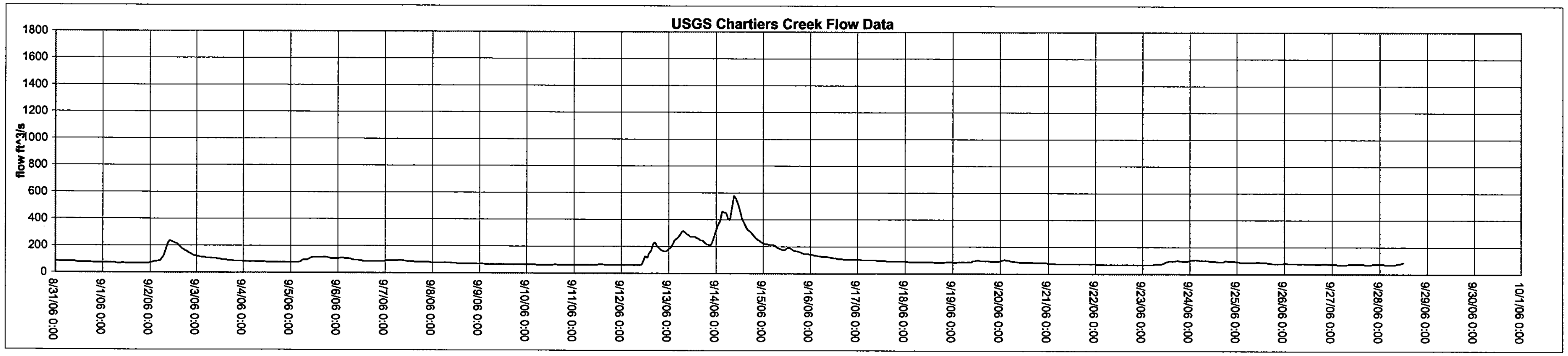


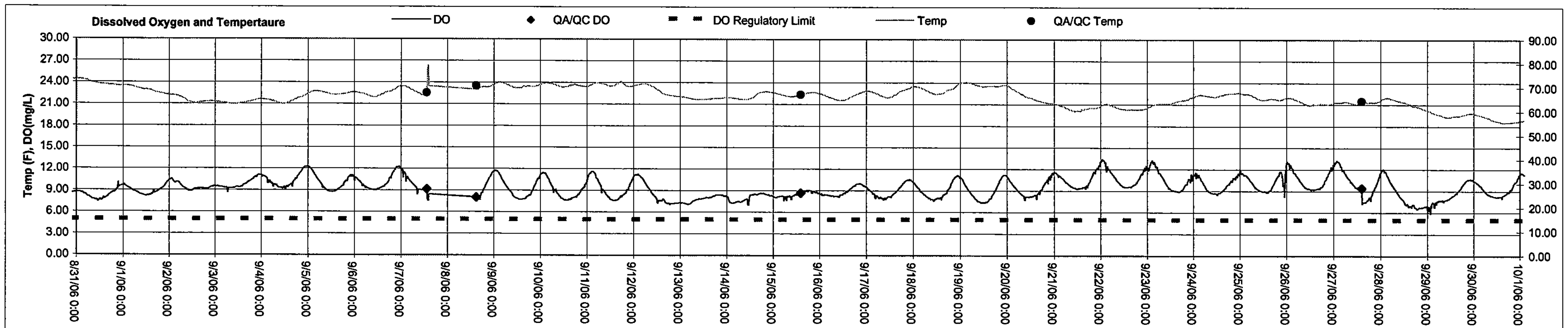
Chartiers Creek 1 - August

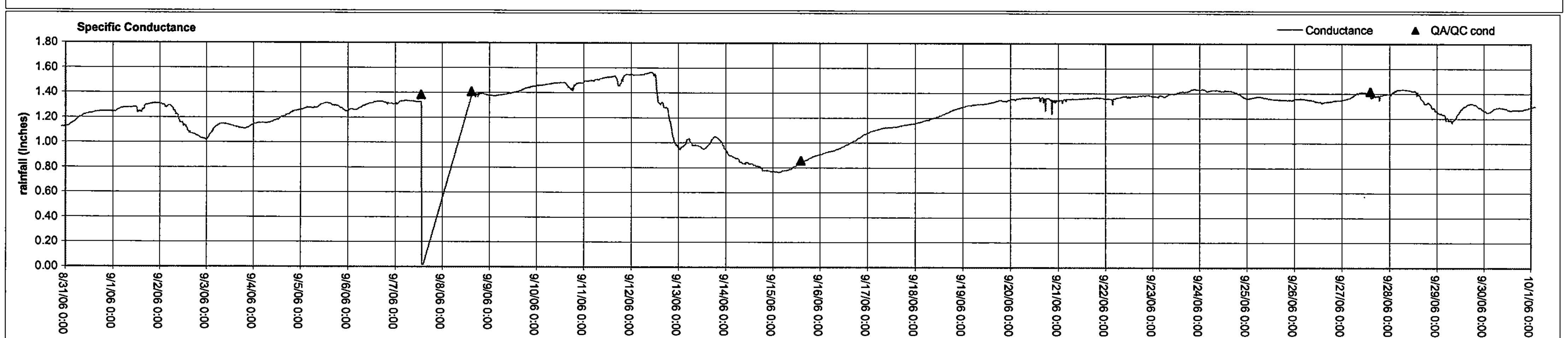


Chartiers Creek 1 - September

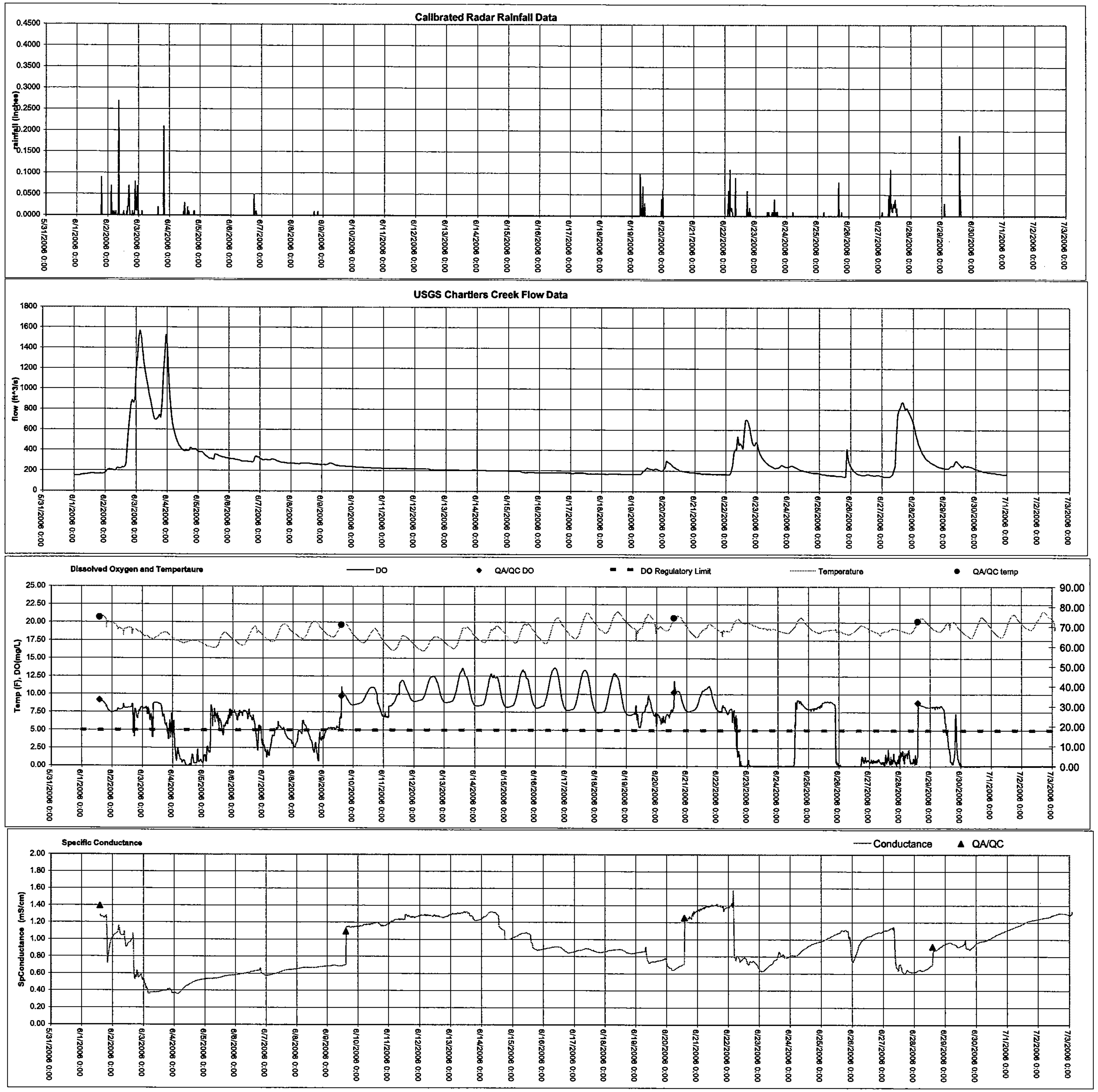




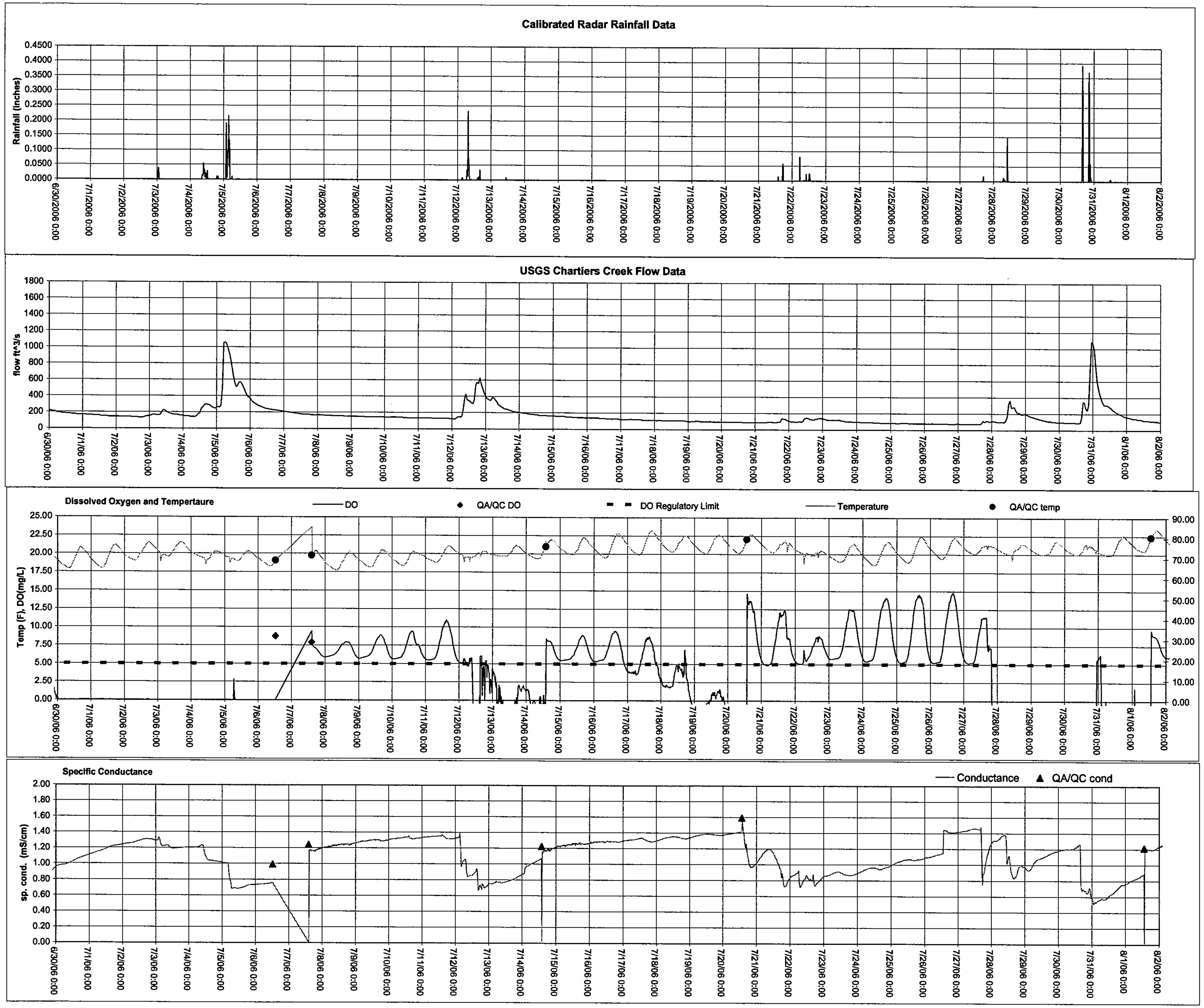




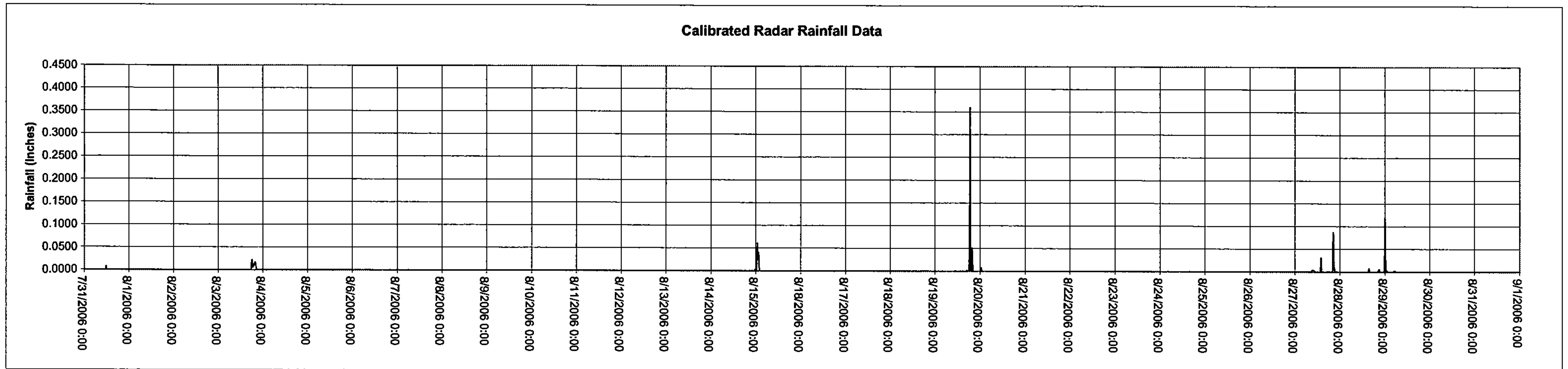
Chartiers Creek 2 - June

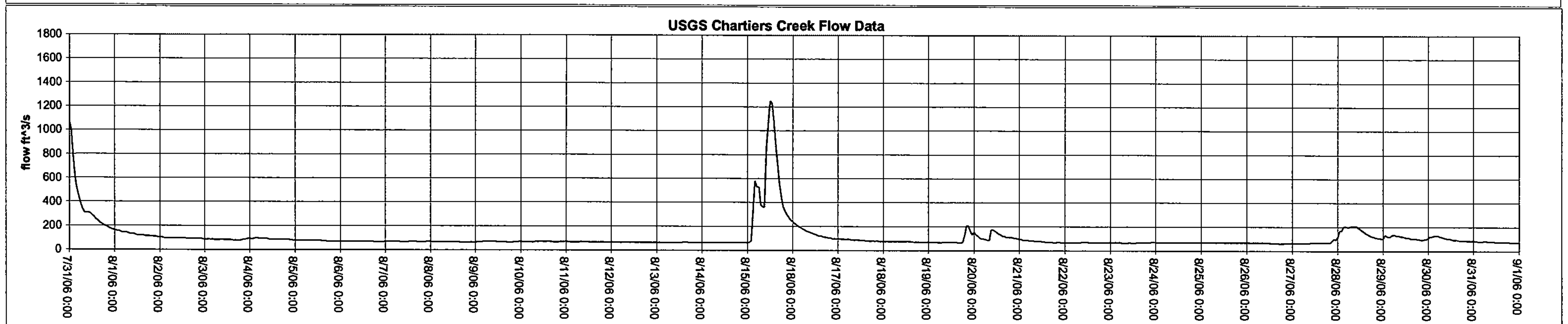


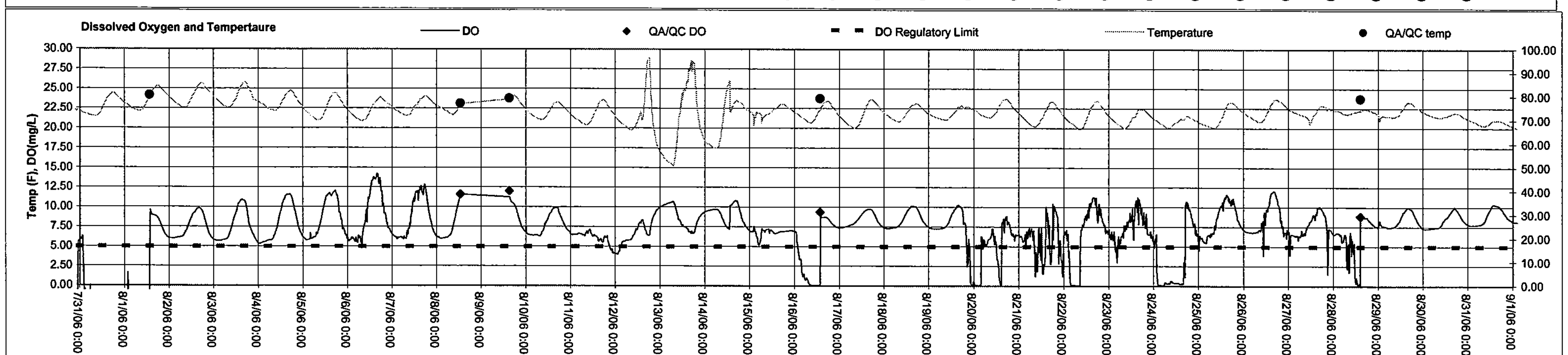
Chartiers Creek 2 - July

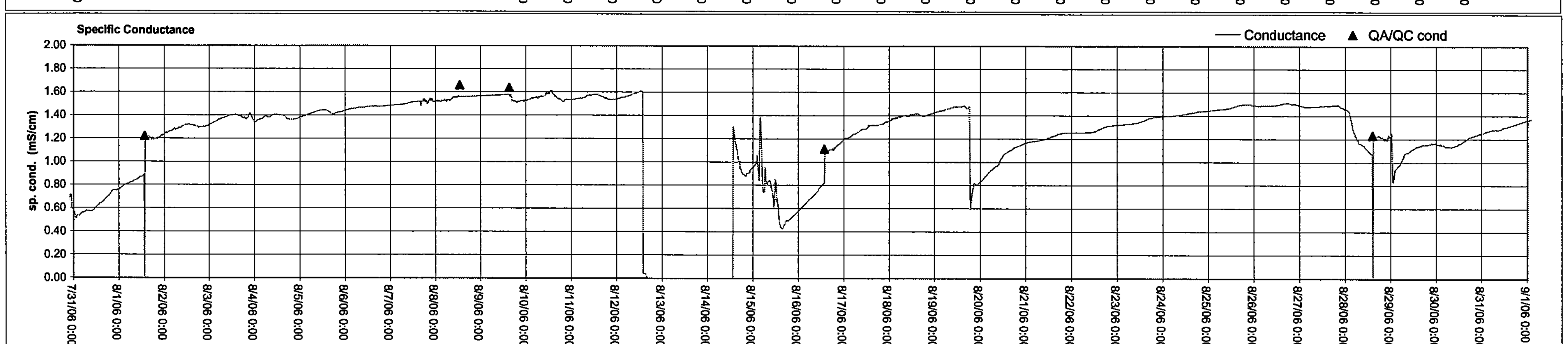


Chartiers Creek 2 - August

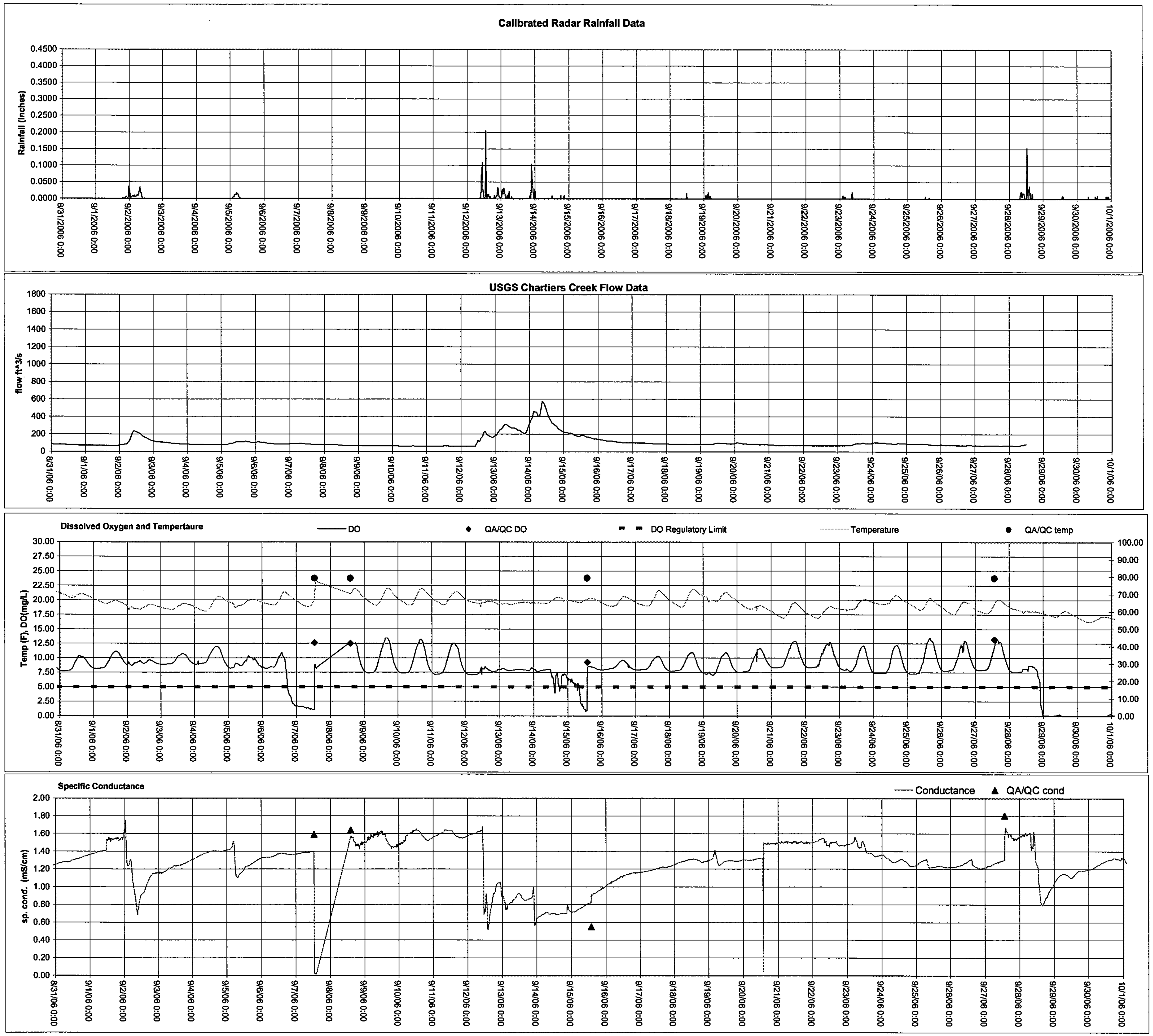




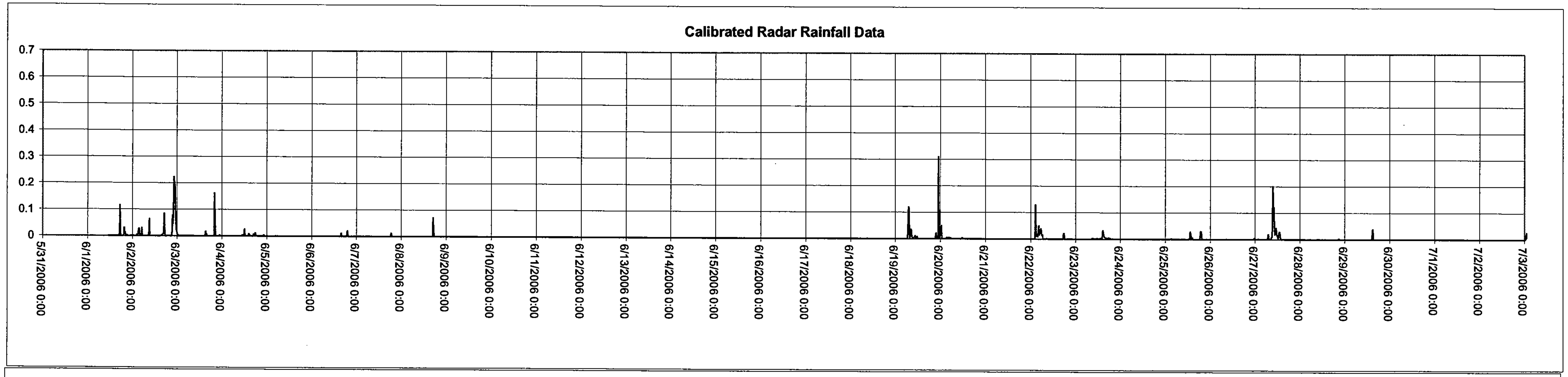


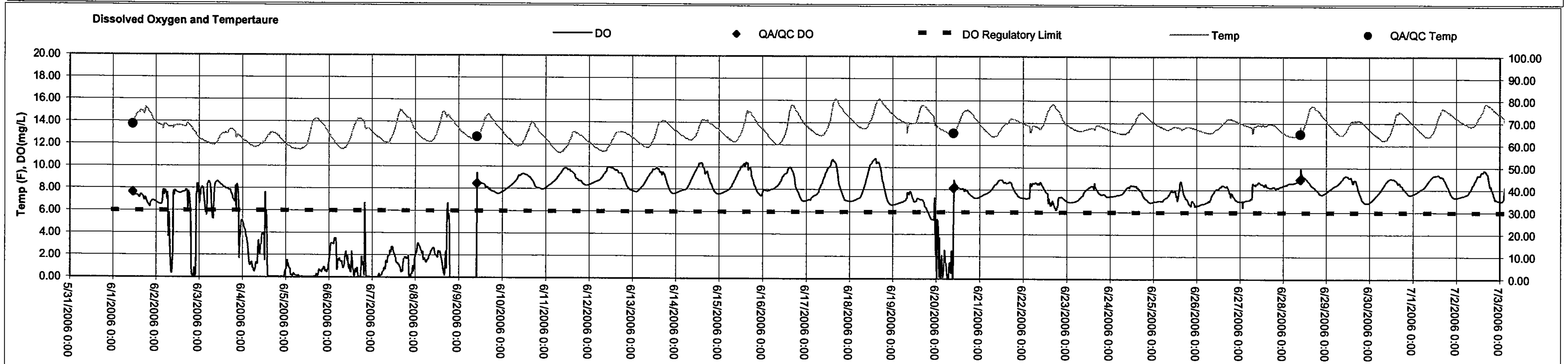


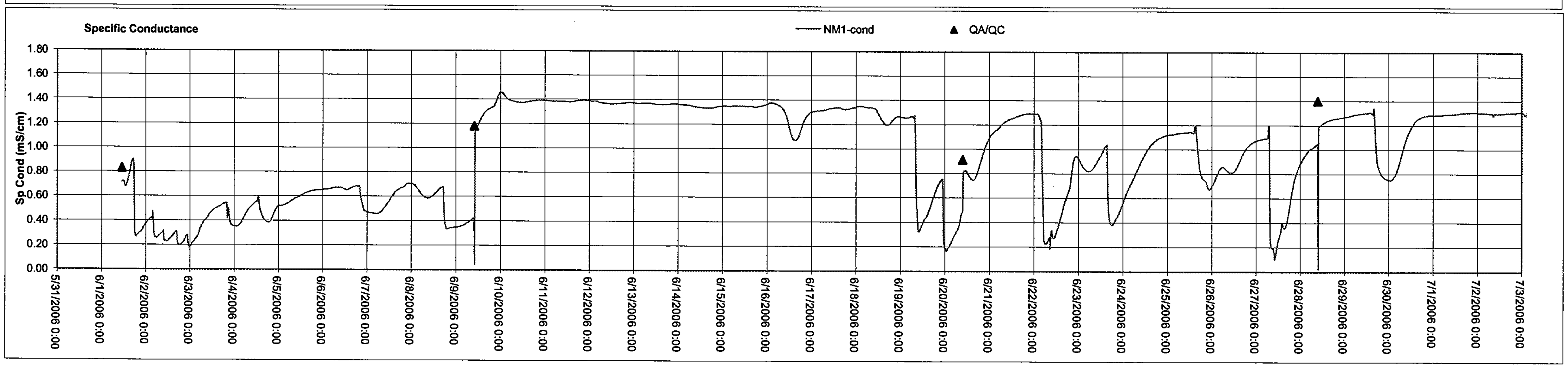
Chartiers Creek 2 - September



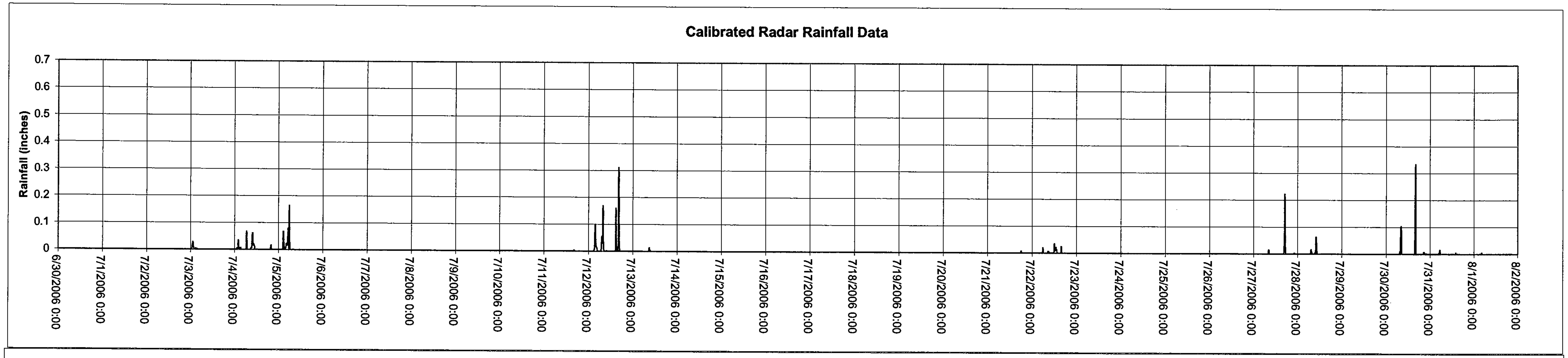
Nine Mile Run 1 - June

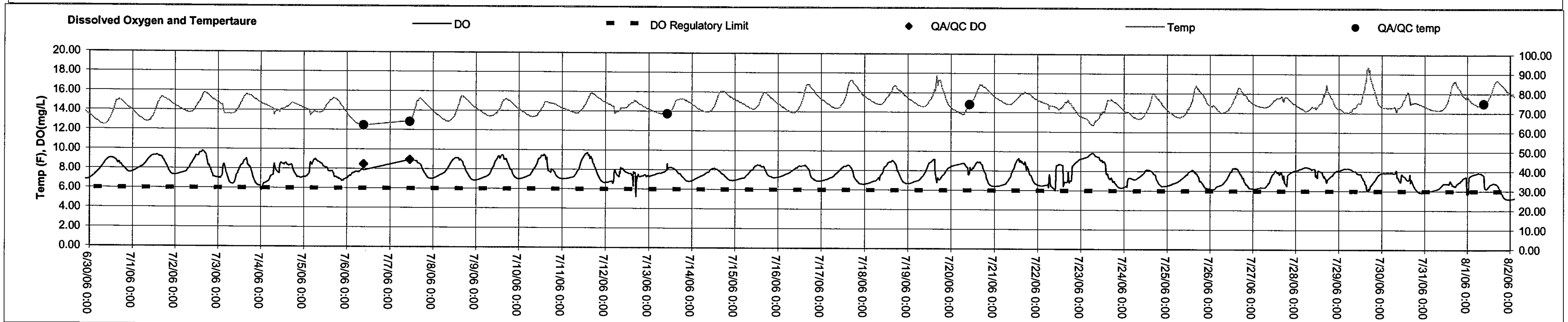


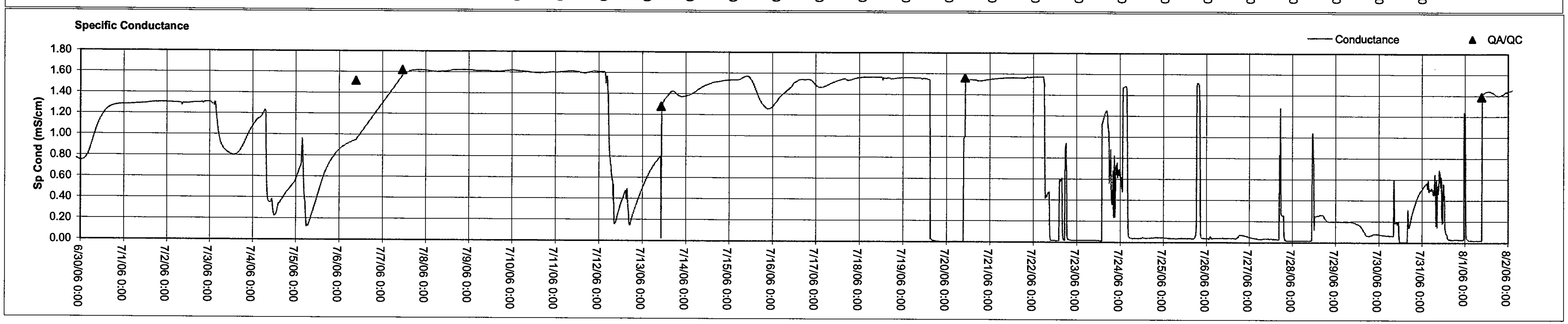




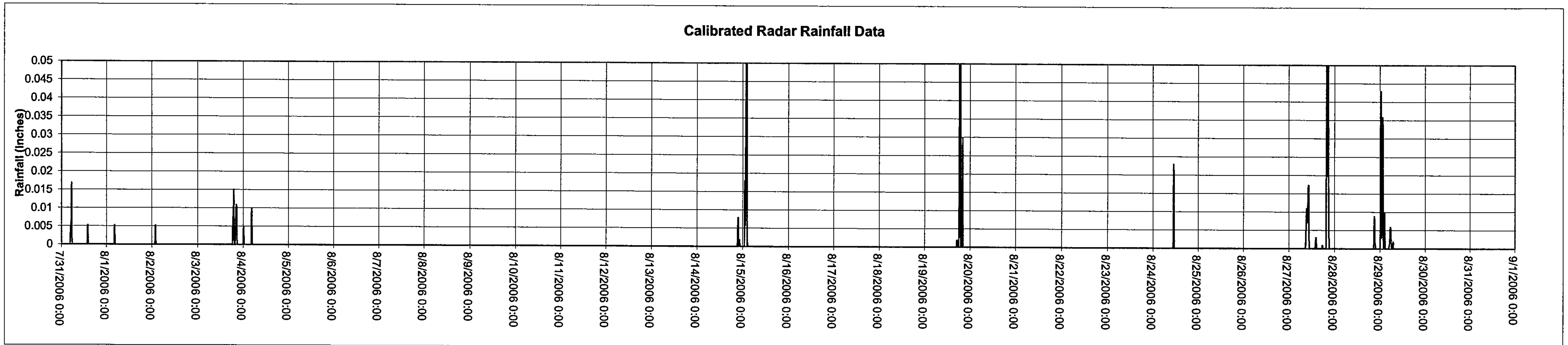
Nine Mile Run 1 - July

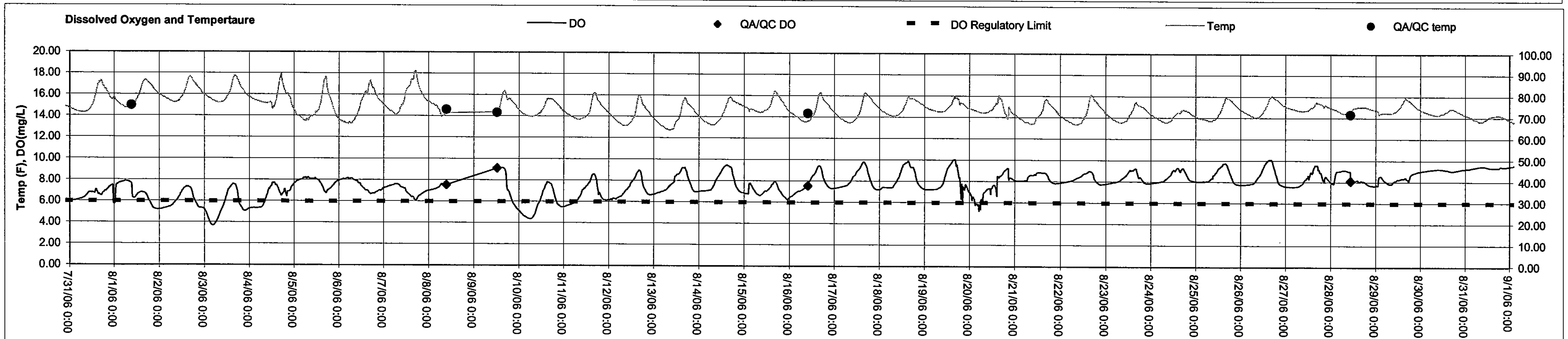


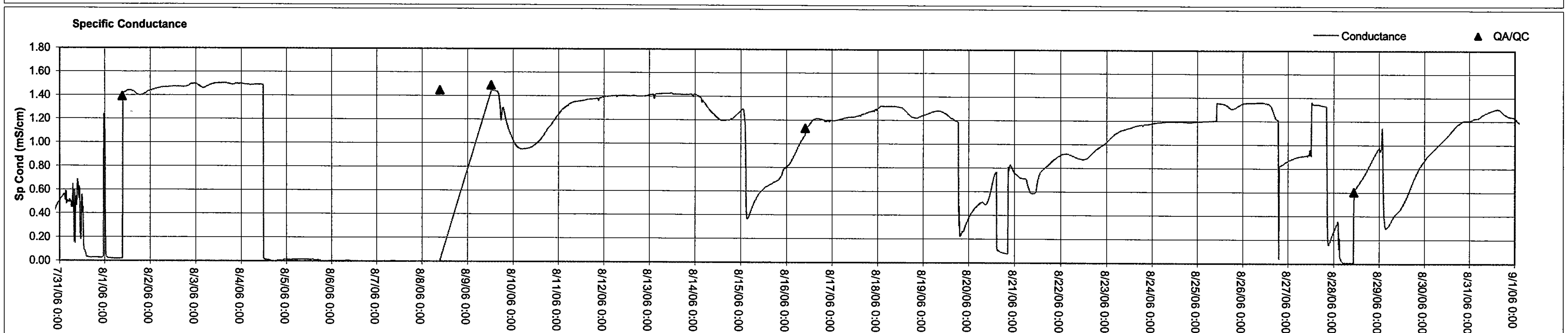




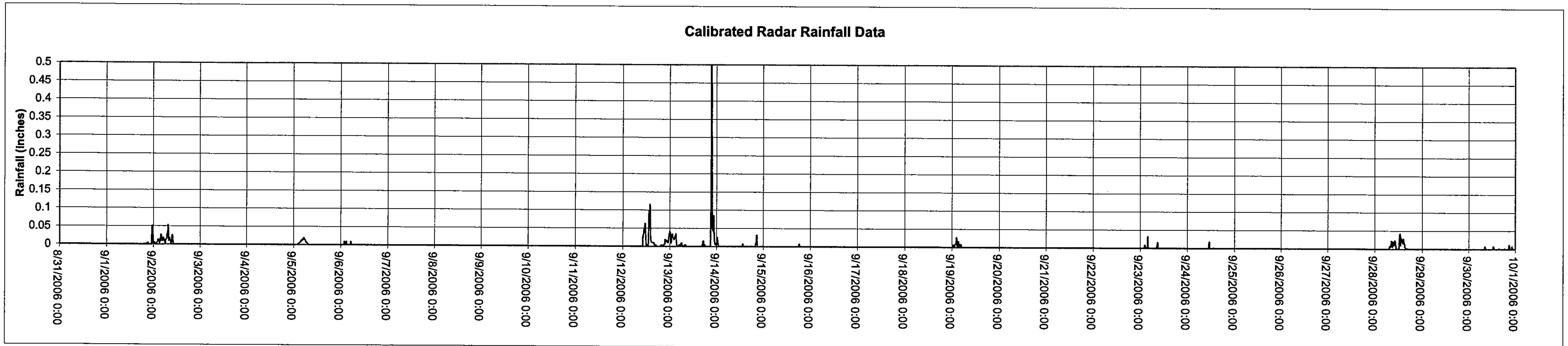
Nine Mile Run 1 - August

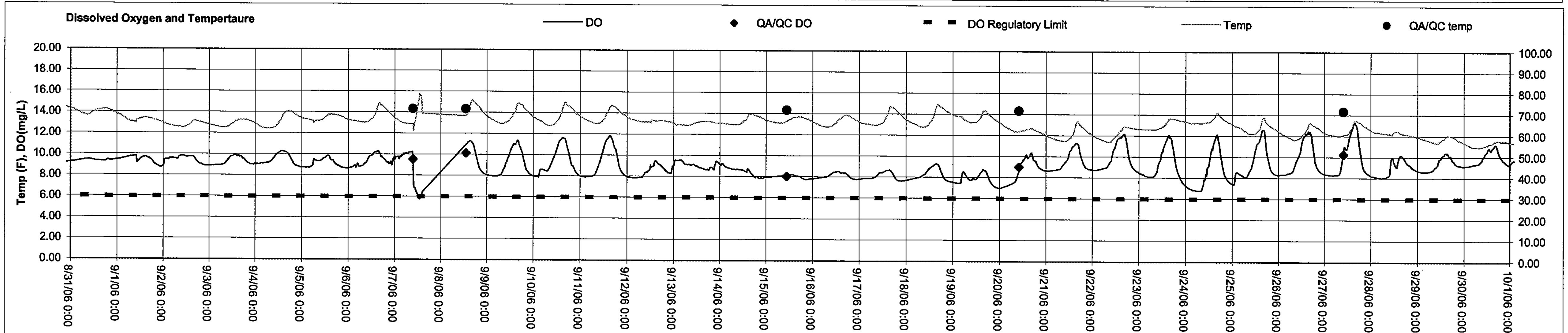


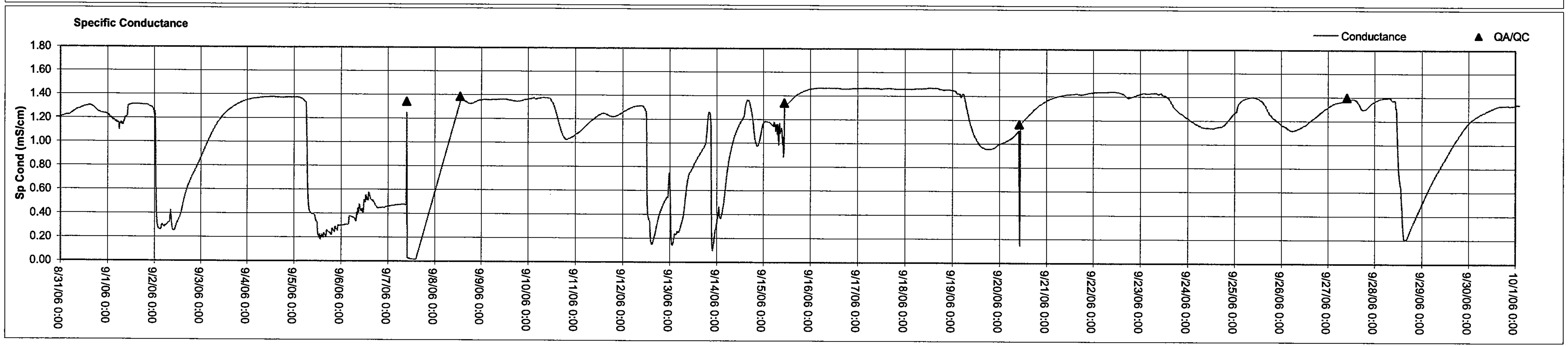




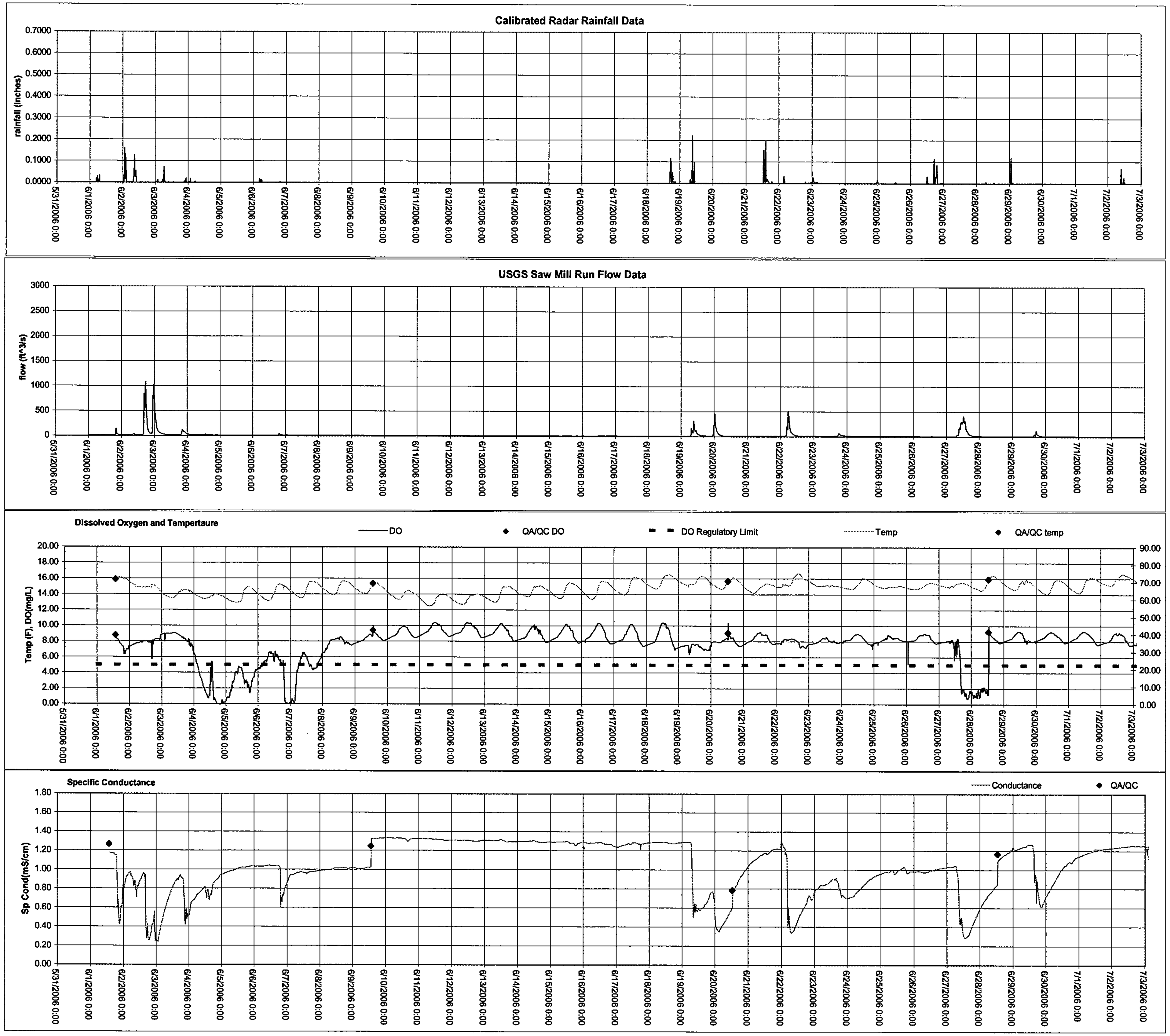
Nine Mile Run 1 - September



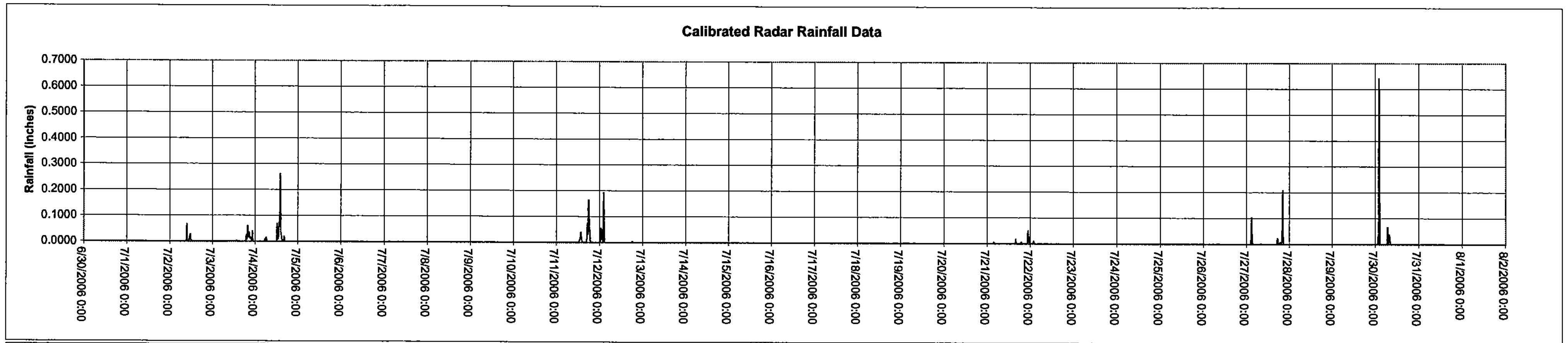


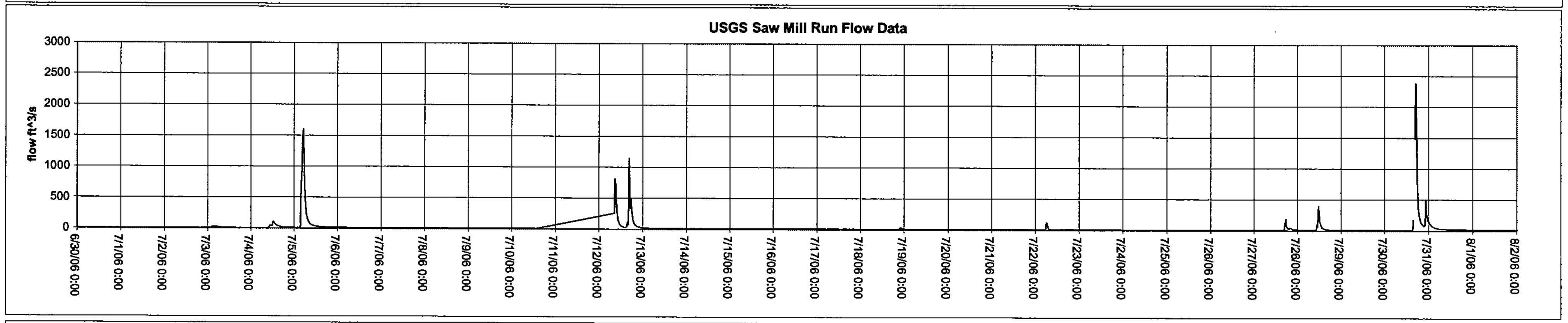


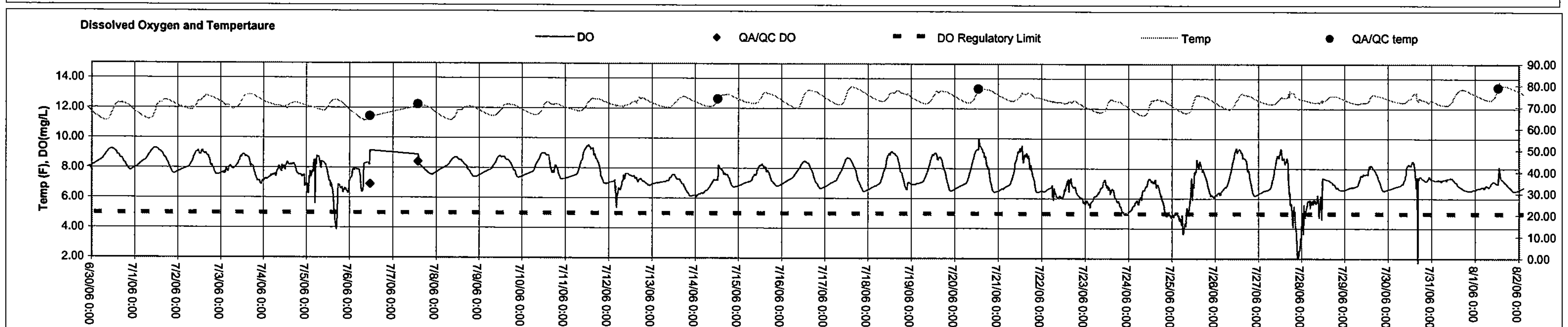
Saw Mill Run 1 - June

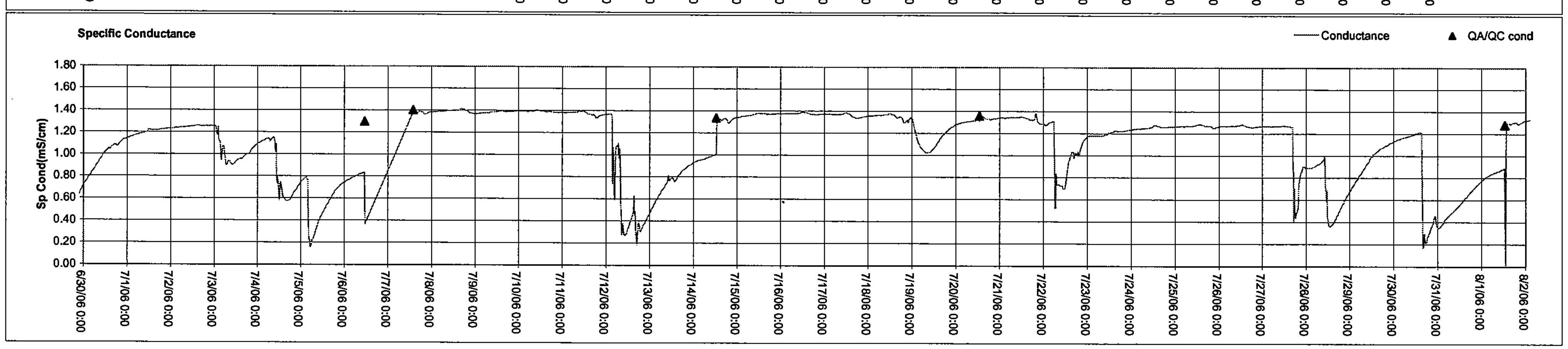


Saw Mill Run 1 - July

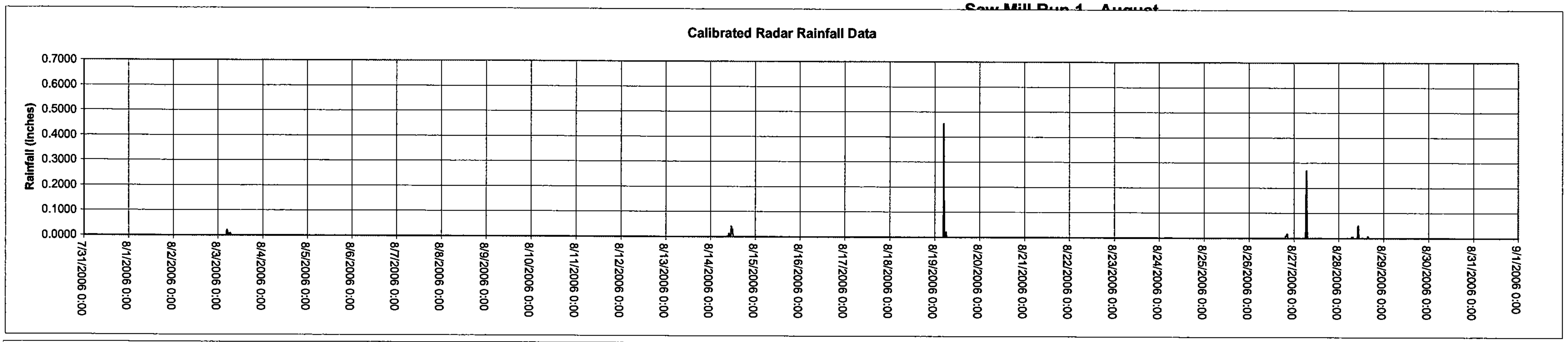


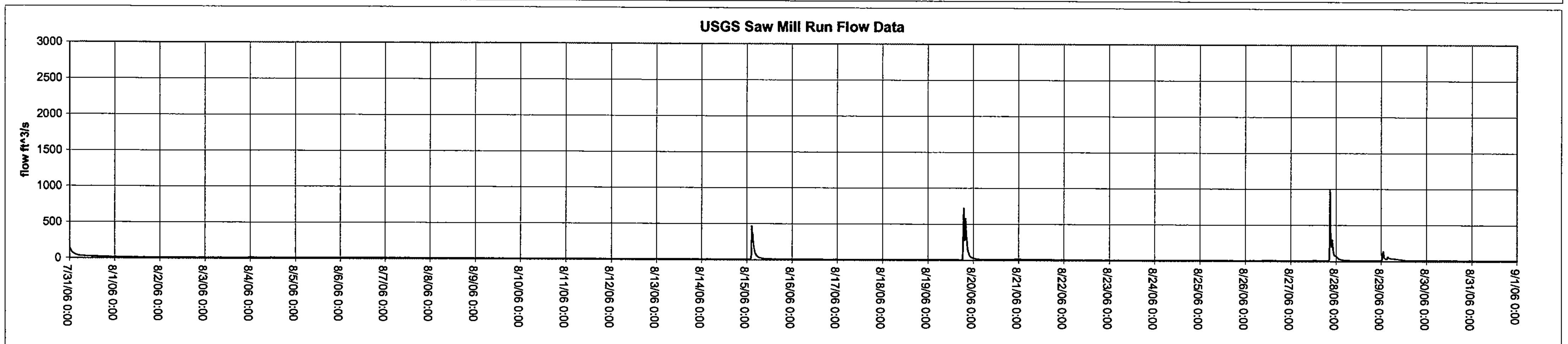


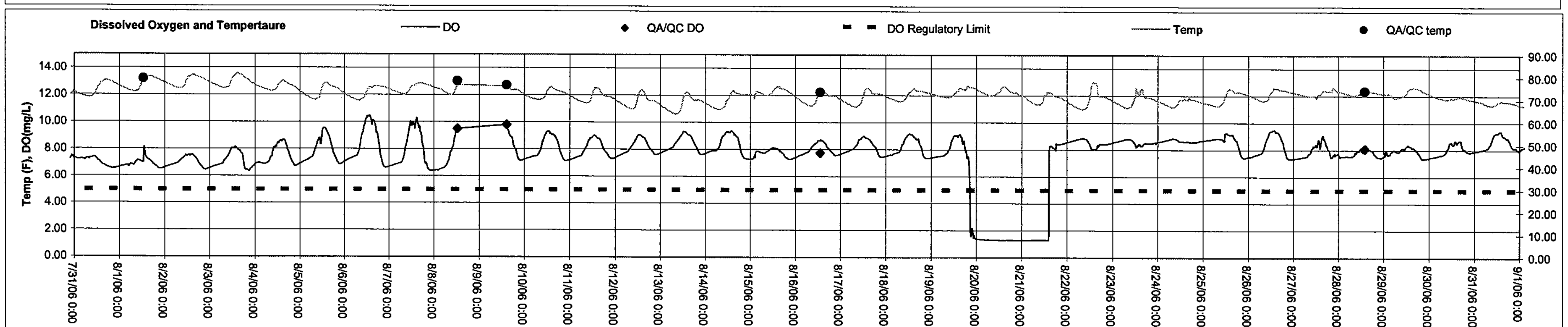


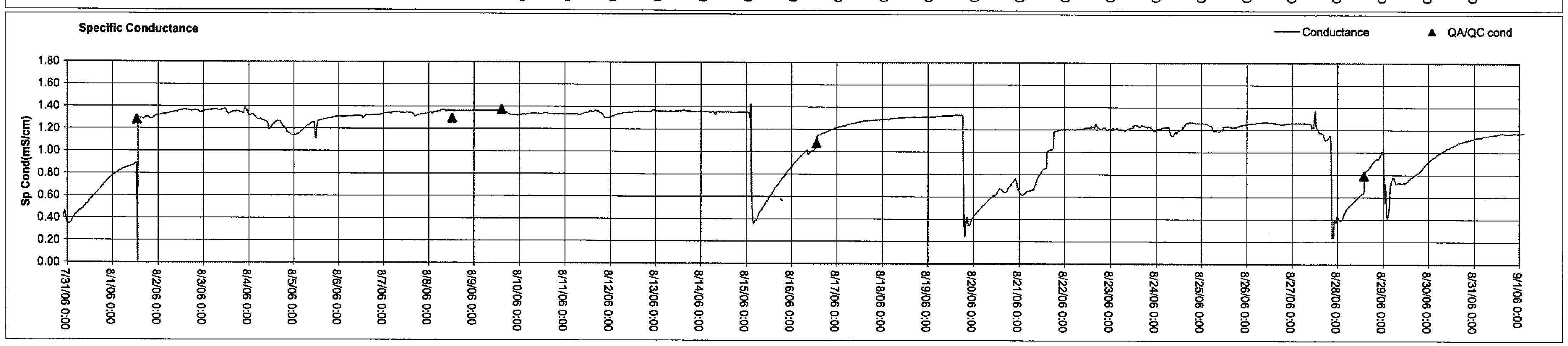


Saw Mill Run 1 - August

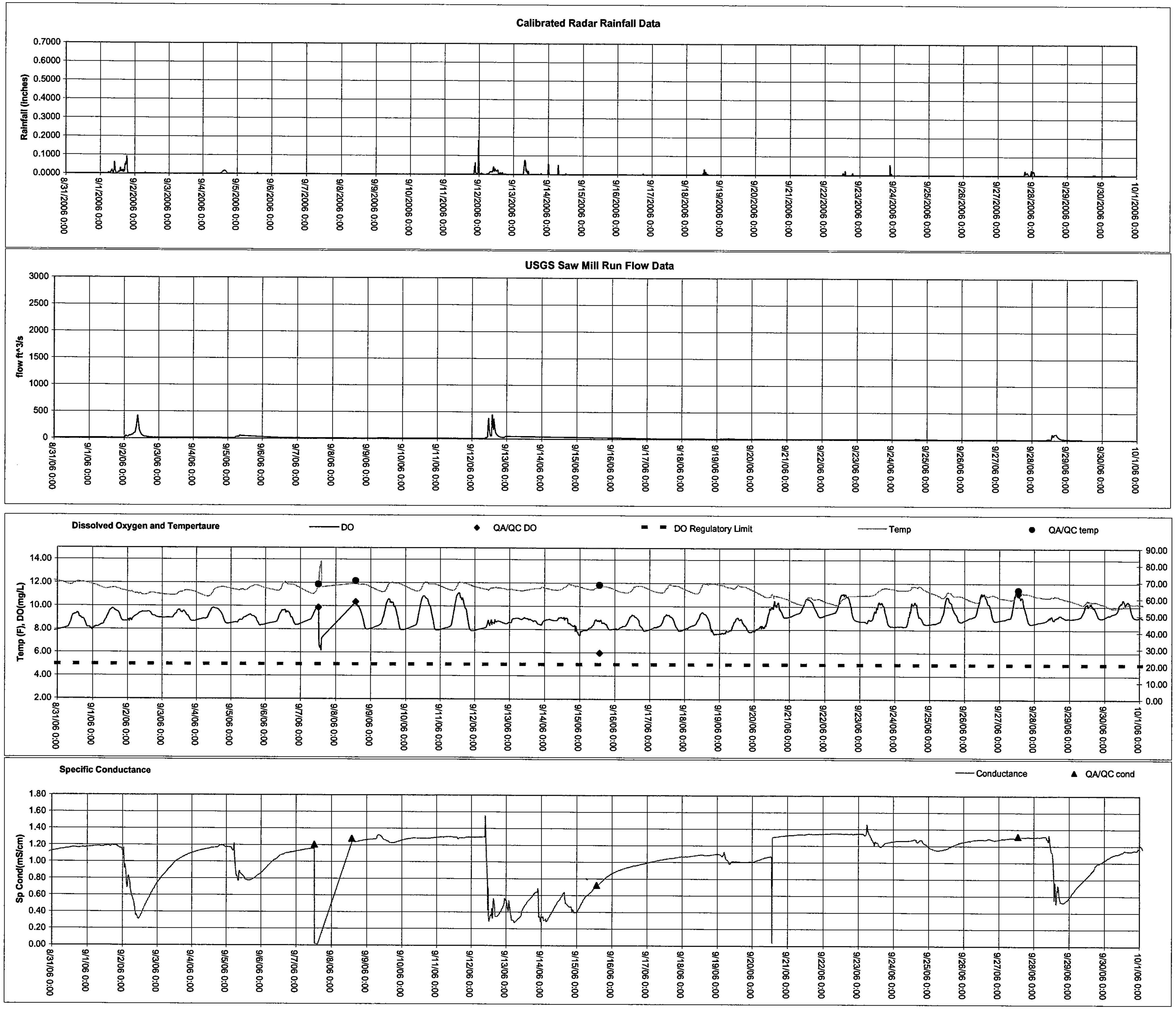




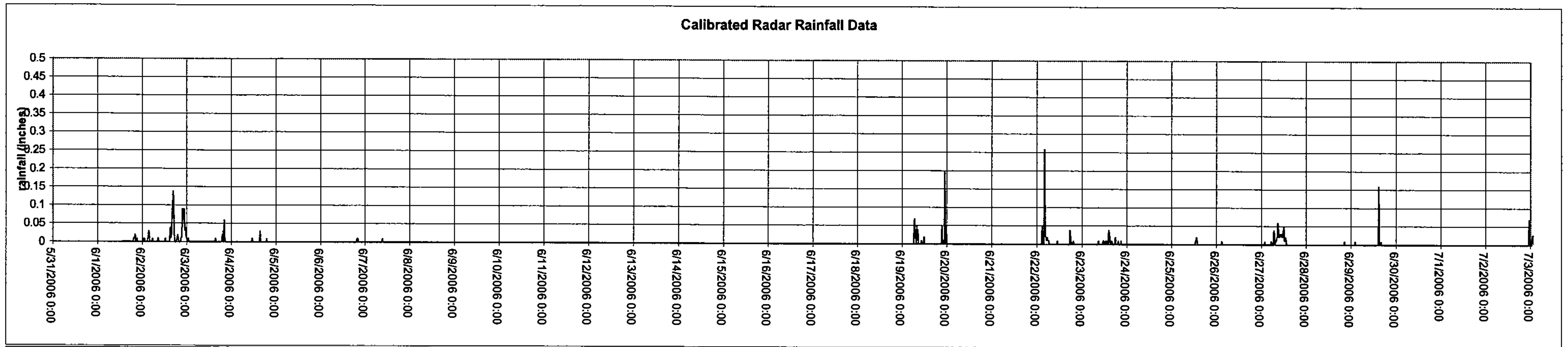


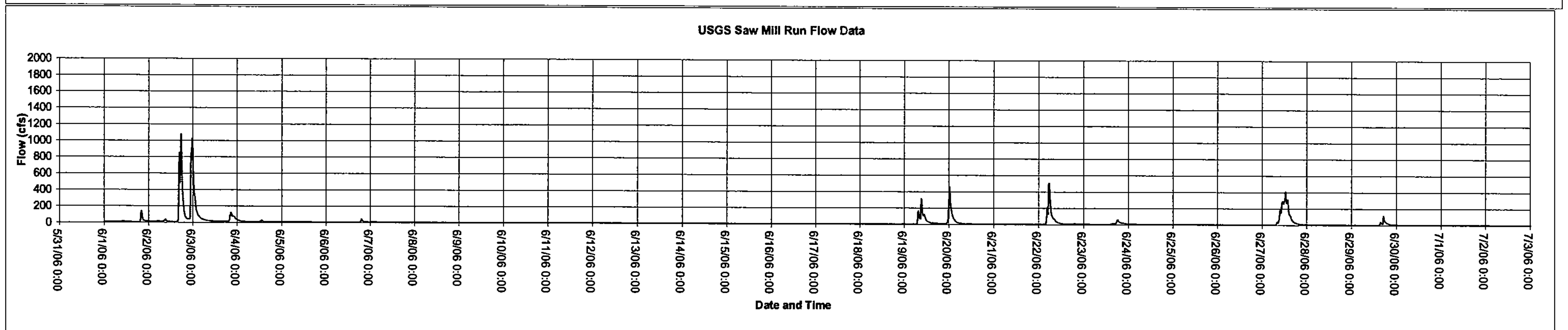


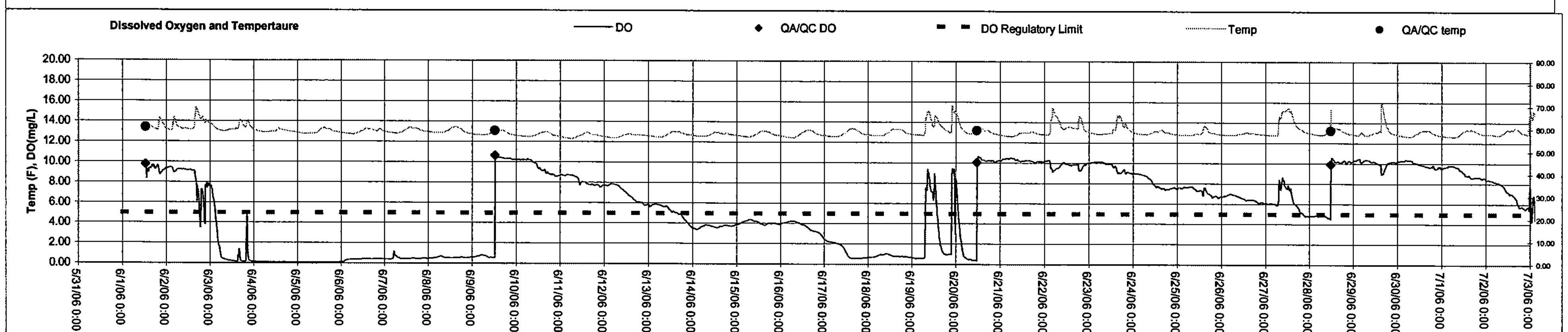
Saw Mill Run 1 - September

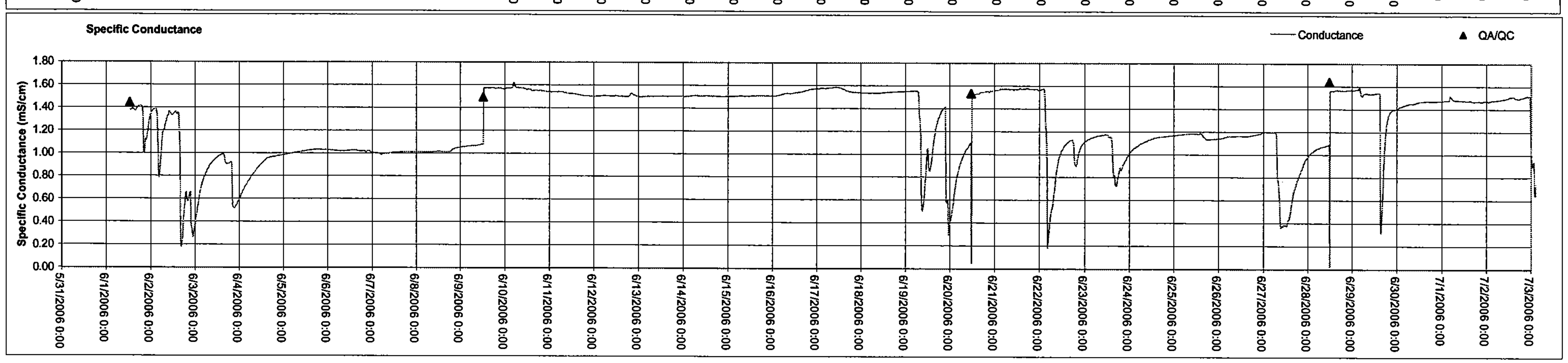


Saw Mill Run 2 - June

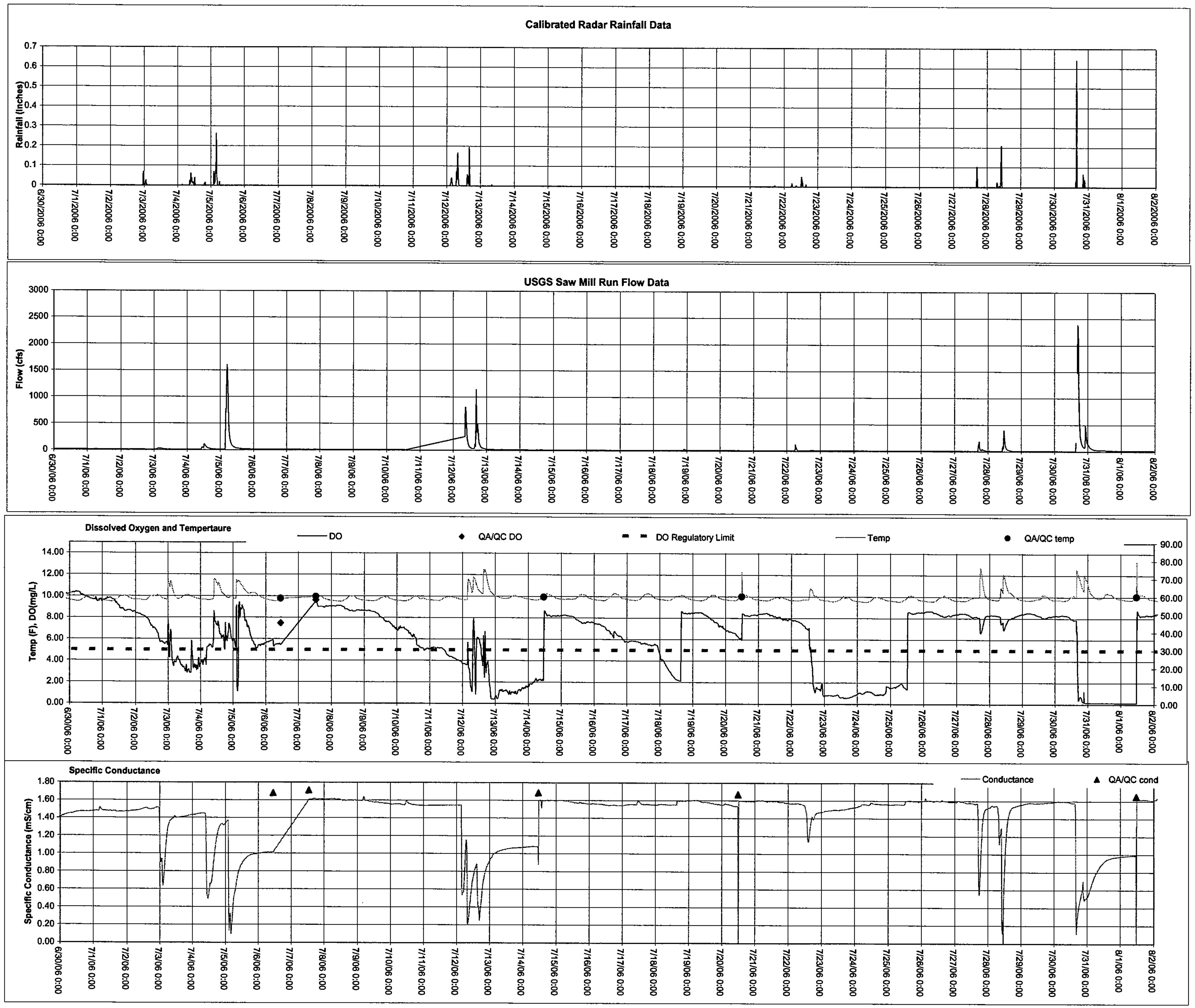




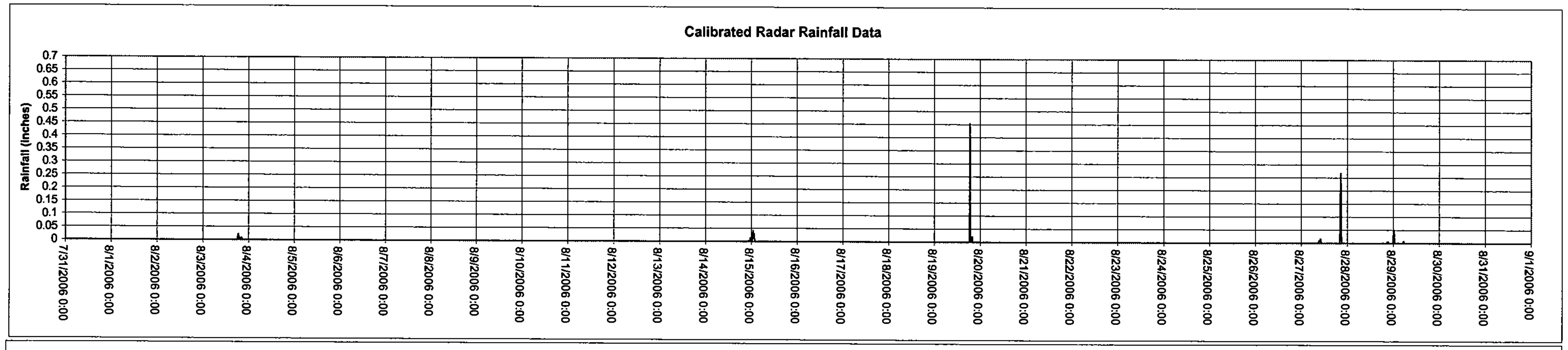


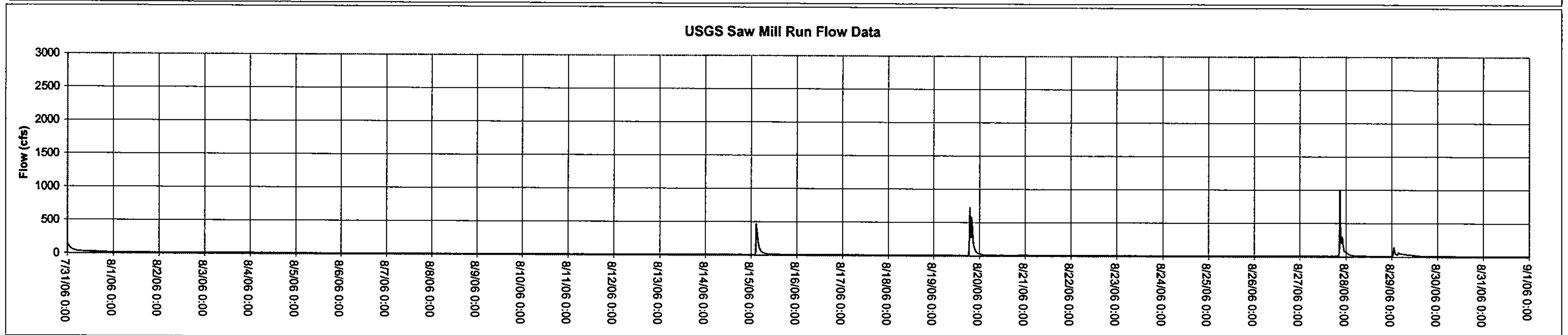


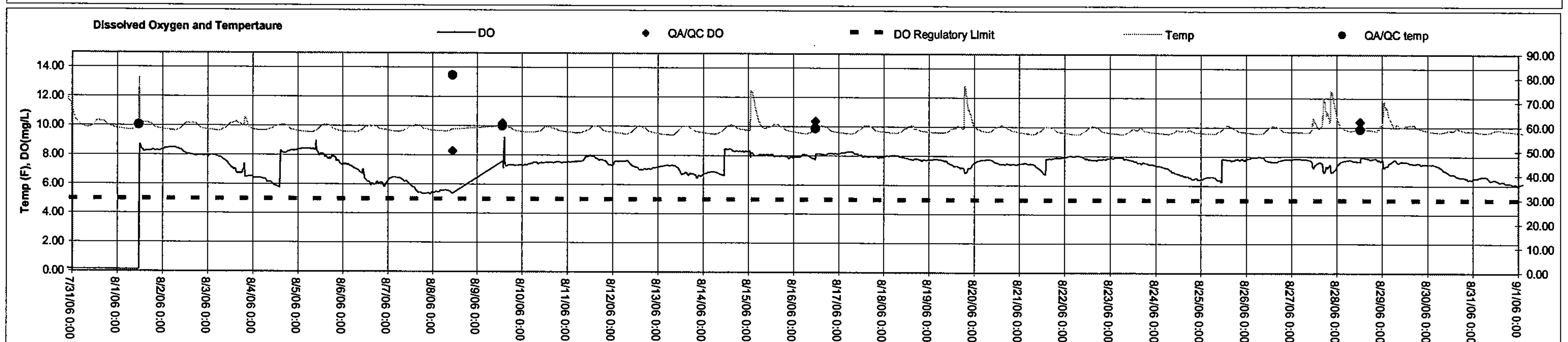
Saw Mill Run 2 - July

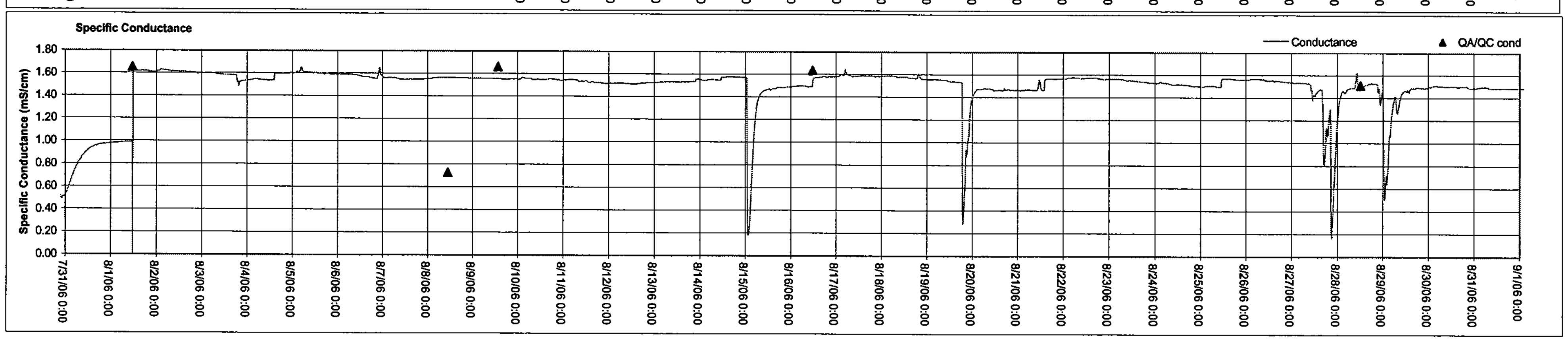


Saw Mill Run 2 - August

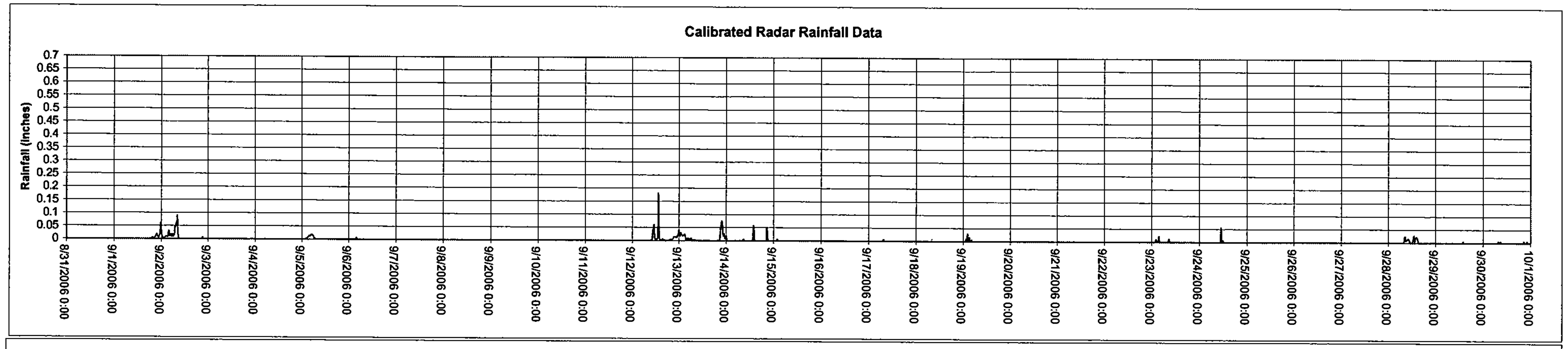


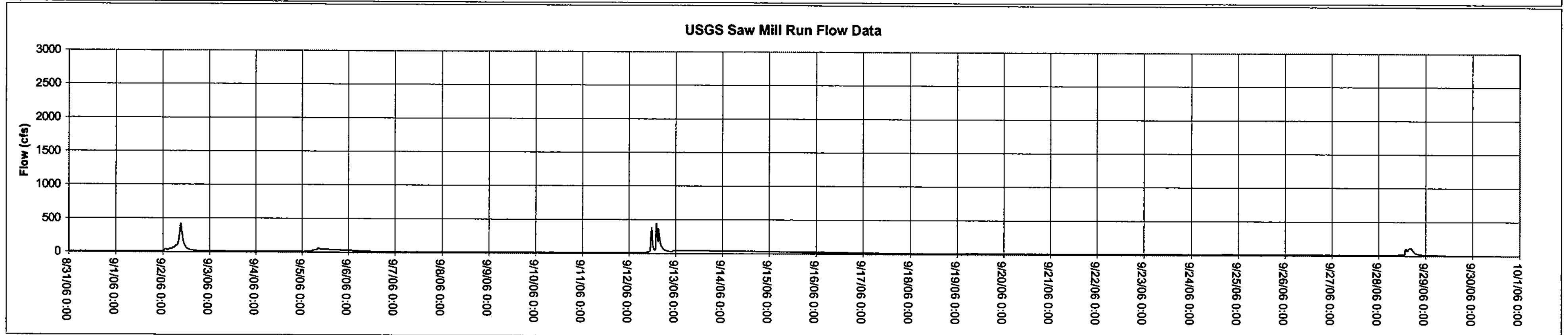


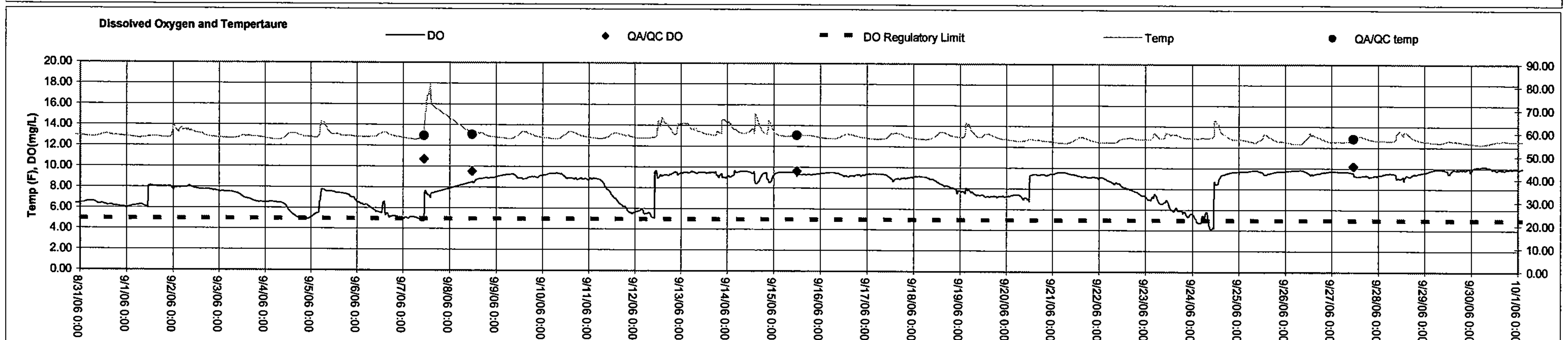


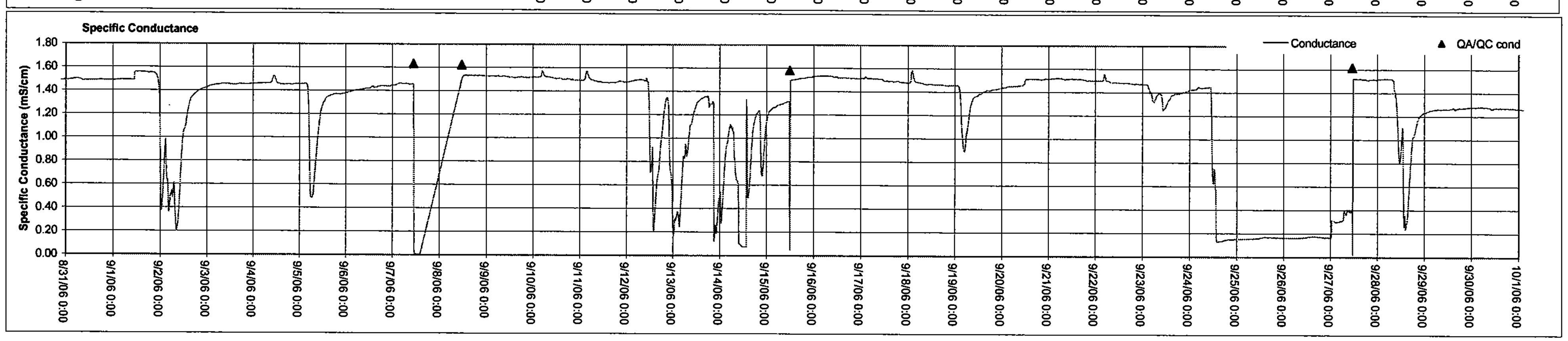


Saw Mill Run 2 - September

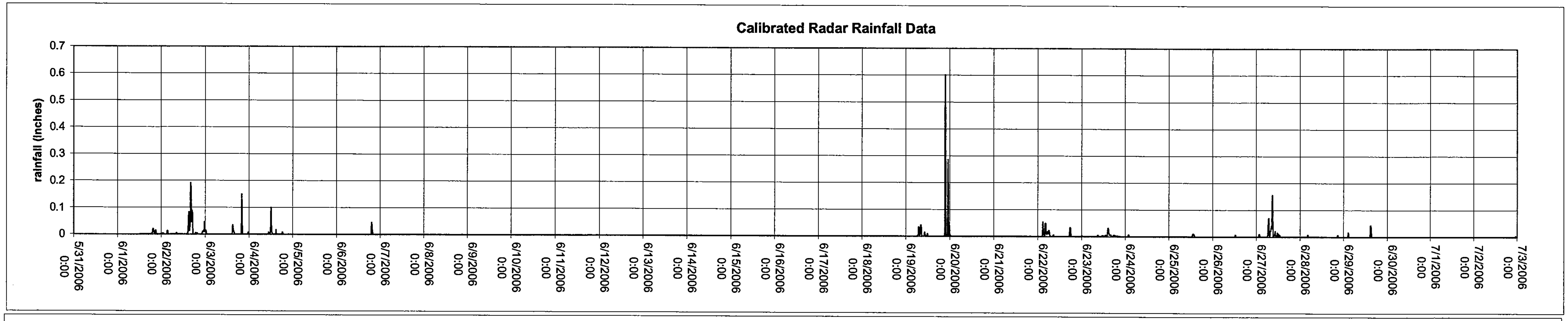


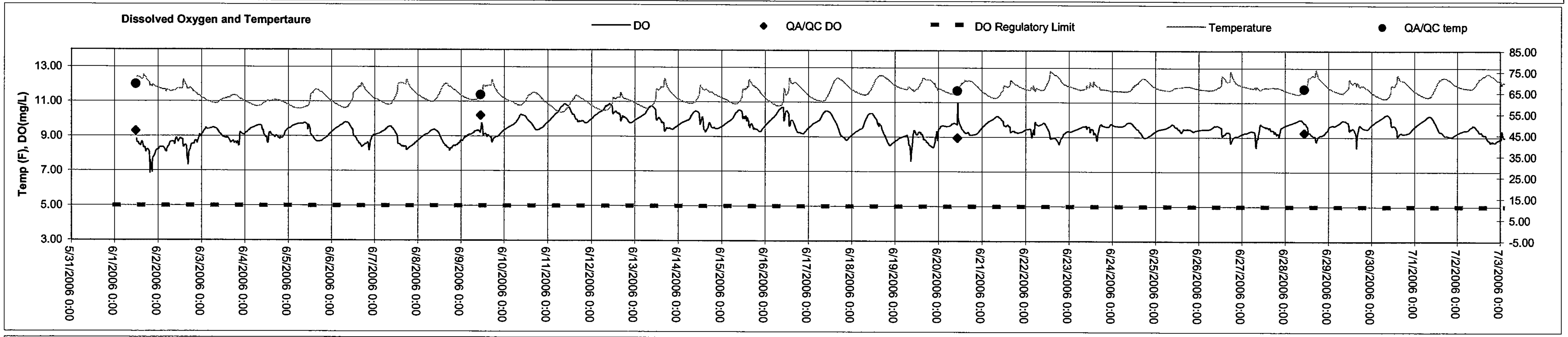


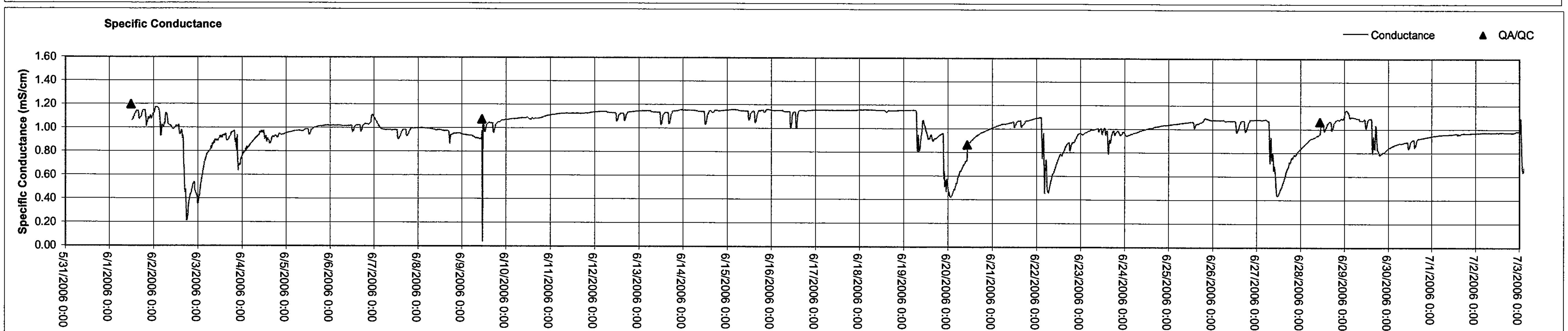




Streets Run 1 - June







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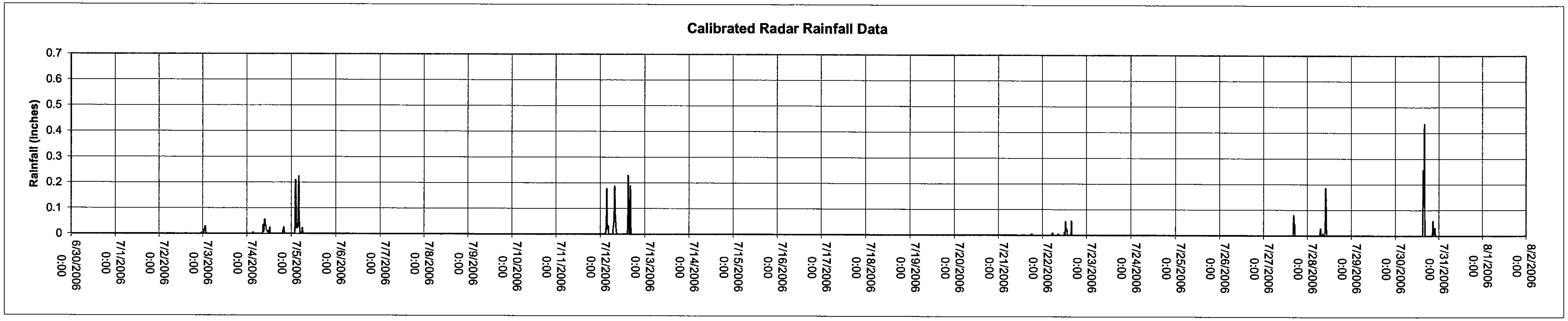
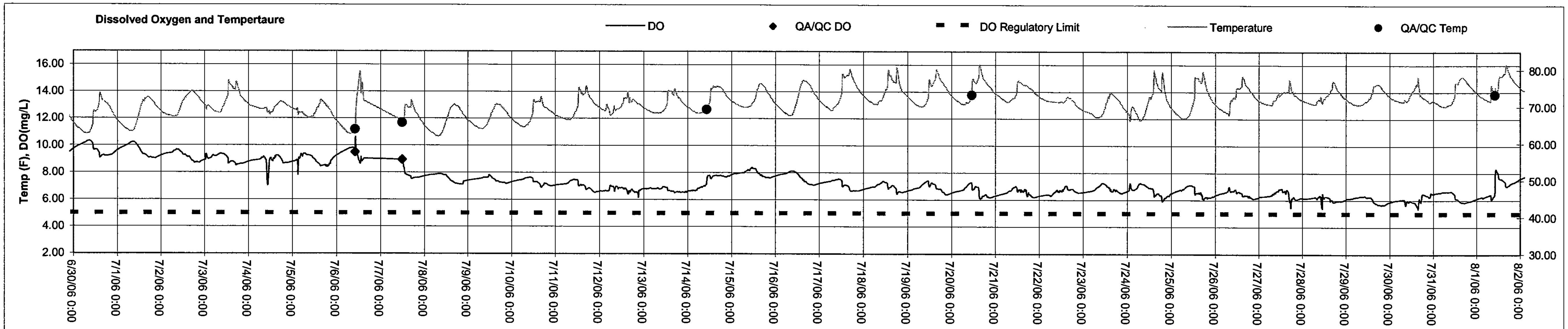
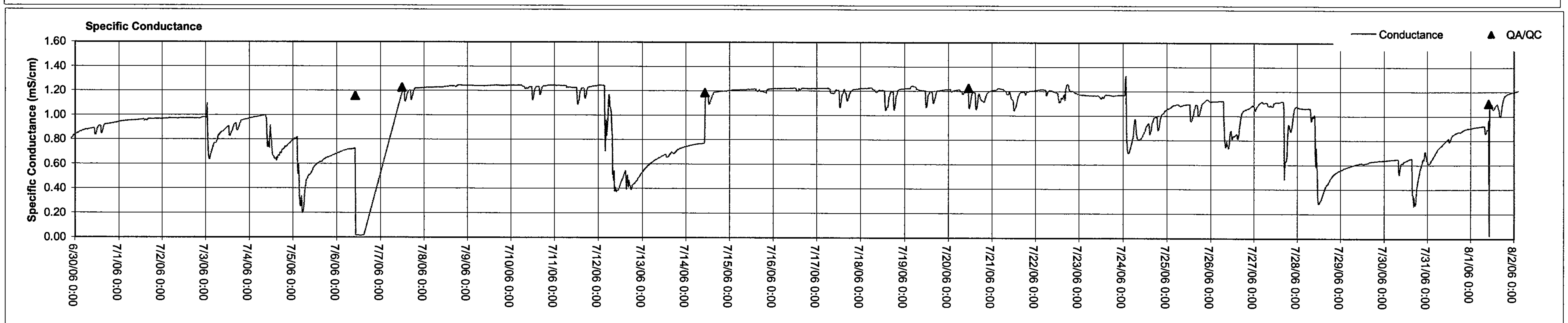
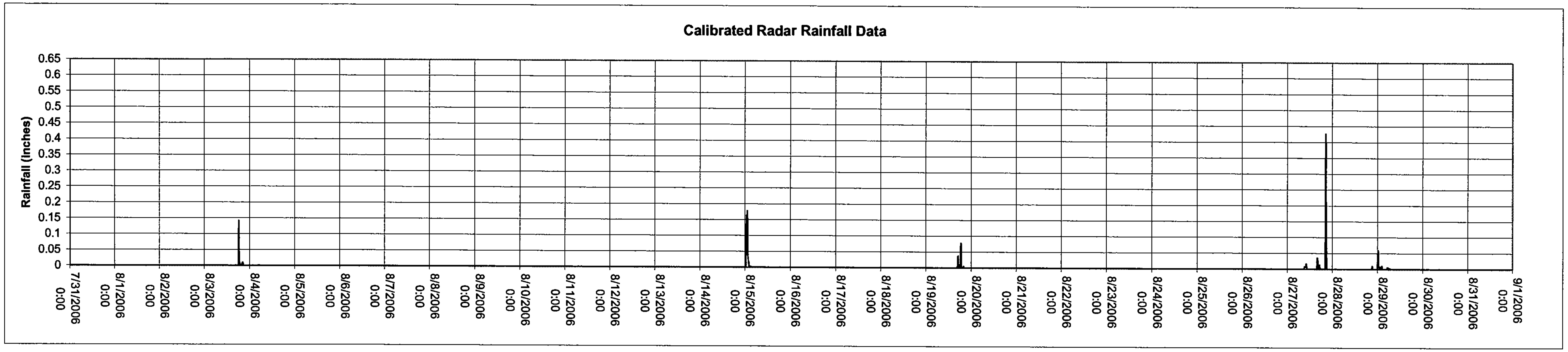
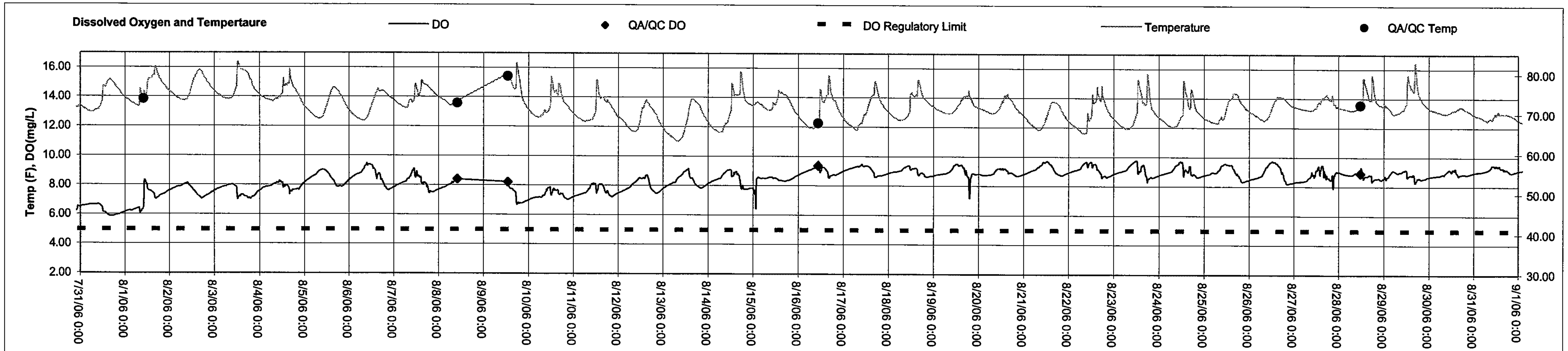


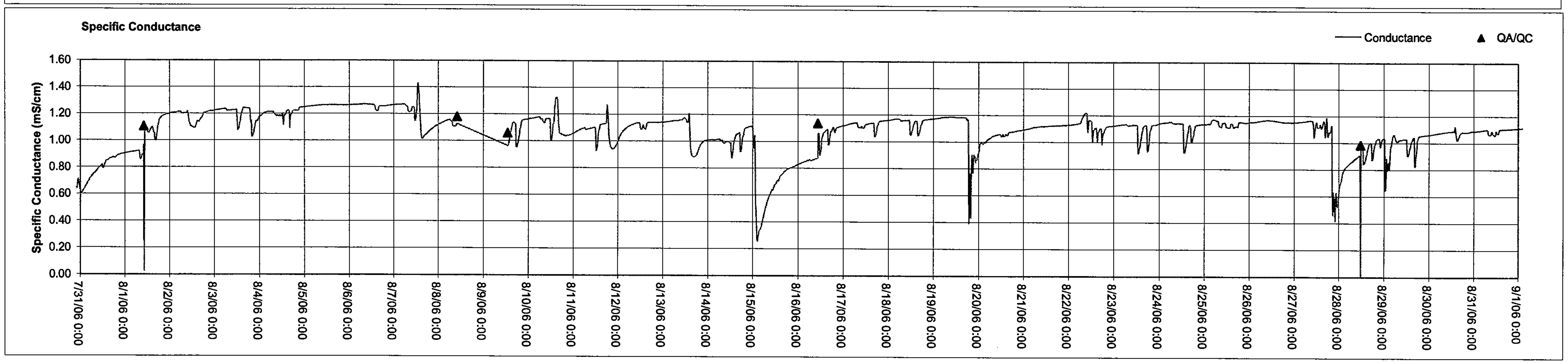




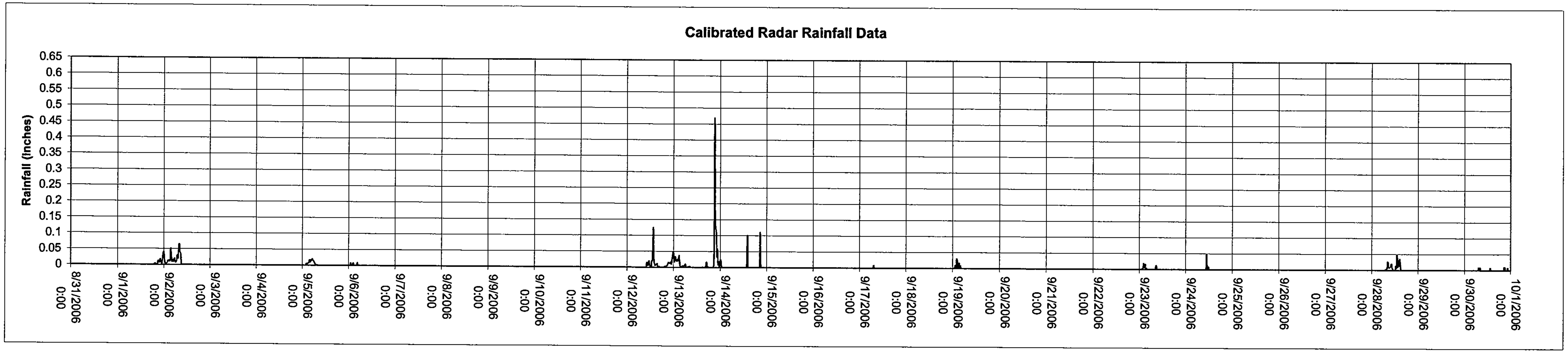
Streets Run 1 - August

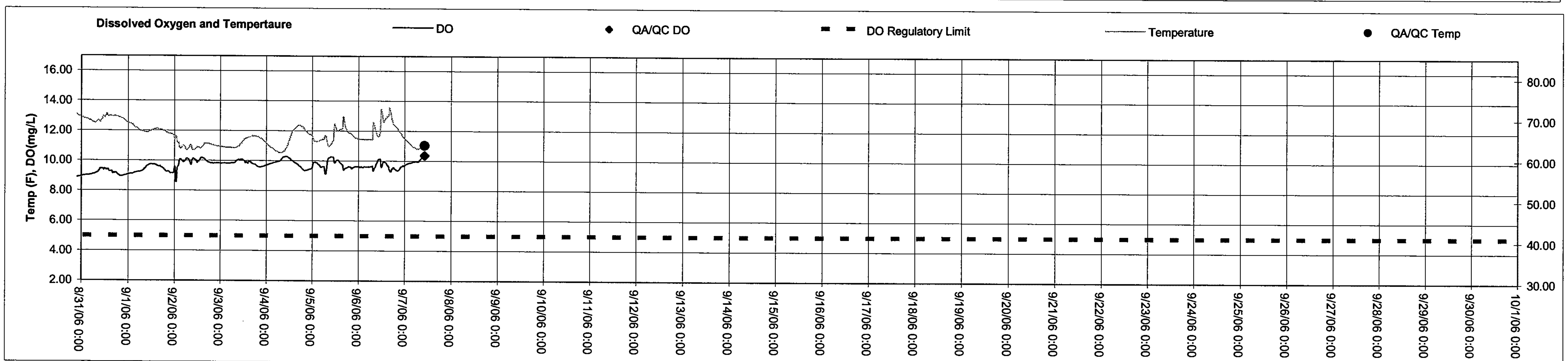


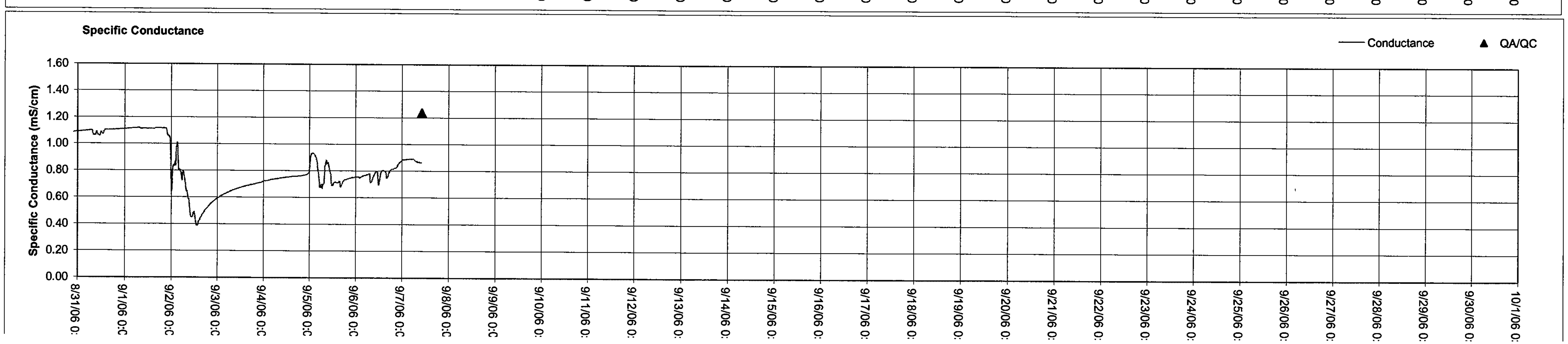




Streets Run 1 - September







ATTACHMENT E
DATA CD:
(RAW DATA, RAINFALL DATA, FLOW DATA, ADJUSTED DATA, FIELD QA/QC DATA, DRY WEATHER ANALYSIS TABLES)

ATTACHMENT F
FIELD QA/QC DATA AND FIELD NOTES

Becks Run 1 - QA/QC Data

Site	QA/QC Date Time	Temp C	Temp F	Cond	DO	pH	Notes	Sediment	Probes	Flow	Weather
BR1	6/1/2006 12:06	21.73	71.11	1.0504	9.81	8.36	redeployed sonde,move sonde to scour hole	N/A	good	N/A	N/A
BR1	6/9/2006 11:49	18.95	66.11	1.0099	11.35	8.09	-	some in tube	good	N/A	N/A
BR1	6/20/2006 10:46	20.17	68.31	0.9668	8.85	7.76	-	some in tube	good	N/A	N/A
BR1	6/28/2006 11:06	20.85	69.53	1.0767	9.1	7.91	put glove on tube	N/A	good	N/A	N/A
BR1	7/6/2006 10:26	18.62	65.52	1.0852	9.39	8.24	changed DO membrame, calibrated @ office	none	good	N/A	N/A
BR1	7/7/2006 12:15	20.19	68.34	1.1076	8.88	8.14	redeployed sonde		good	N/A	N/A
BR1	7/14/2006 10:44	21.52	70.74	1.081	-1	8.26	installed milk jug float; DO Charge was less than 25 so DO reading not accurate	none	good	N/A	N/A
BR1	7/20/2006 11:24	24.19	75.54	1.104	-1	8.26	changed batteries; DO Charge was less than 25 so DO reading not accurate	none	good	low	sunny
BR1	8/1/2006 10:36	24.37	75.87	1.038	-1	8.19	DO Charge was less than 25 so DO reading not accurate; float was missing so replaced it with another milk jug; glove ripped; algae on rocks	some in tube	good	low	sunny 90F humid
BR1	8/8/2006 10:18	23.53	74.35	1.448	7.52	8.29	algae on rocks	none	good	low	sunny 80F
BR1	8/9/2006 13:09	23.76	74.77	1.042	9.23	8.02	redeployed sonde; replaced DO probe with a new one; had to replace DO probe before redeploying due to low DO charge that couldn't be corrected	NA	good	low	sunny 85F
BR1	8/16/2006 11:00	21.31	70.36	1.02	9.53	8.3	sonde was out of water; changed DO membrane and calibrated; algae on rocks	none	good	low	sunny 80F
BR1	8/28/2006 11:50	22.97	73.35	0.871	8.65	8.5	probes intact	none	good	low	overcast 75F
BR1	9/7/2006 10:27	17.8	64.04	1.044	10.39	8.62	pulled sonde for maintenance				
BR1	9/8/2006 11:46	19.57	67.23	1.045	9.24	7.97	redeployed sonde				
BR1	9/15/2006 11:11	19.08	66.34	0.95	8.93	8.36	sonde good				
BR1	9/27/2006 10:20	15.74	60.33	1.08	10.58	8.21					

QA/QC reading not accurate; don't use

Chartiers Creek 1 - QA/QC Data

Site	QA/QC Date Time	Temp C	Temp F	Cond	DO	pH	Notes	Sediment	Probes	Weather	Flow
CC1	6/1/2006 14:50	24.3	75.74	1.1811	2.47	7.49	redeployed sonde	N/A	good	N/A	N/A
CC1	6/9/2006 13:50	20.28	68.50	0.9663	9.25	7.28	-	N/A	good	N/A	N/A
CC1	6/20/2006 13:08	21.96	71.53	1.0111	7.52	7.73	-	N/A	good	N/A	N/A
CC1	6/28/2006 13:21	21.42	70.56	0.7486	7.75	7.87	-	N/A	good	N/A	N/A
CC1	7/6/2006 13:10	20.35	68.63	0.8211	8.69	8.2	changed DO membrame, calibrated @ office	none	good	N/A	N/A
CC1	7/7/2006 15:05	20.08	68.14	1.0208	8.75	8.07	redeployed sonde	N/A	good	N/A	N/A
CC1	7/14/2006 13:07	23.39	74.10	0.979	-1	8.06	raised pipe up a few inches to reduce impact from sediment; DO Charge below 25 so DO reading not accurate	N/A	good	N/A	N/A
CC1	7/20/2006 14:19	27.13	80.83	1.401	-1	8.19	changed batteries; DO Charge below 25 so DO reading not accurate	none	good	sunny	normal height
CC1	8/1/2006 14:10	26.73	80.11	0.948	-1	8.22	DO charge below 25 so DO reading not accurate	none	good	sunny 90F humid	normal height
CC1	8/8/2006 13:29	27.17	80.91	1.293	7.12	8		none	good	sunny 80F	normal height
CC1	8/9/2006 15:42	28.79	83.82	0.406	9.2	8.22	redployed sonde	none	good	sunny 85F	normal height
CC1	8/16/2006 14:30	24.52	76.14	0.008	8.76	8.08		none	good	sunny 80F	normal height
CC1	8/28/2006 15:05	23.65	74.57	1.304	8.27	8.15		none	good	overcast 75F	normal height
CC1	9/7/2006 13:12	19.82	67.68	1.384	9.16	8.4	pulled sonde for maintenance				
CC1	9/8/2006 14:52	21.47	70.65	1.409	8.02	8.37	redployed sonde				
CC1	9/15/2006 14:10	19.49	67.08	0.86	8.69	8.17		none	good		
CC1	9/27/2006 14:12	18.08	64.54	1.418	9.42	8.42					

QA/QC reading not accurate; don't use

Chartiers Creek 2 - QA/QC Data

Site	QA/QC Date Time	Temp C	Temp F	Cond	DO	pH	Notes	Sediment	Probes	Weather	Flow
CC2	6/1/2006 13:59	23.61	74.50	1.3937	9.18	7.86	redeployed sonde	N/A	good	N/A	N/A
CC2	6/9/2006 14:37	21.52	70.74	1.0932	9.76	8.01	-	some in the tube	good	N/A	N/A
CC2	6/20/2006 13:44	23.49	74.28	1.2559	10.28	7.85	-	small amounts of sediment	good	N/A	N/A
CC2	6/28/2006 14:04	22.57	72.63	0.9179	8.83	7.81	put glove on sonde	N/A	good	N/A	N/A
CC2	7/6/2006 12:25	20.34	68.61	0.9942	8.73	7.97	changed DO membrane and calibrated @ office	small amounts of sediment	good	N/A	N/A
CC2	7/7/2006 14:23	21.7	71.06	1.2449	7.89	8.01	redeployed sonde	N/A	good	N/A	N/A
CC2	7/14/2006 13:52	24.23	75.61	1.224	-1	8.02	installed float; DO Charge below 25 so DO reading not accurate	some inside tube	good	N/A	N/A
CC2	7/20/2006 13:33	26.31	79.36	1.593	-1	8.41	changed batteries; DO Charge below 25 so DO reading not accurate; deployment pipe covered in layer of silt but probes not covered	no sediment	good	sunny	low
CC2	8/1/2006 13:24	26.96	80.53	1.22	-1	8.1	DO charge below 25 so DO reading not accurate; algae on rocks	some sediment in pipe - may be blocking probes	good	sunny 90F humid	normal height
CC2	8/8/2006 12:48	24.99	76.98	1.662	11.6	8.1	algae on rocks	no sediment	good	sunny 80F	low
CC2	8/9/2006 15:05	26.2	79.16	1.639	12.02	7.88	redeployed sonde	NA	good	sunny 85F	low
CC2	8/16/2006 13:46	23.74	79.16	1.114	9.37	7.91		none	good	sunny 80F	normal height
CC2	8/28/2006 14:25	23.7	79.16	1.234	8.85	7.91	cinched up zip-ties on float so it will float sooner during high flows to try to avoid sediment accumulation	probably blocking probes	good	overcast 75F	normal height
CC2	9/7/2006 12:40	19.86	79.16	1.59	12.63	8.11	pulled sonde for maintenance				
CC2	9/8/2006 14:10	21.2	79.16	1.642	12.5	8.35	redeployed sonde				
CC2	9/15/2006 13:45	19.58	79.16	0.551	9.25	8.17	sonde ok				
CC2	9/27/2006 13:32	18.23	79.16	1.805	13.21	8.28	sonde ok				

QA/QC reading not accurate; don't use

Nine Mile Run 1 - QA/QC Data

Site	QA/QC Date Time	Temp C	Temp F	Cond	DO	pH	Notes	Sediment	Probes	DO Membrame	Weather	Flow
nine mile	6/1/2006 10:57	20.42	68.76	0.8313	7.66	7.64	redeployed sonde	N/A	good	good	N/A	N/A
nine mile	6/9/2006 9:57	17.36	63.25	1.1797	8.46	7.85	sonde buried under an inch of sediment, reinstalled sonde in scour area	lots of sediment inside of tube	good	good	N/A	N/A
nine mile	6/20/2006 9:31	18.51	65.32	0.9129	8.15	7.49	-	some inside tube	good	good	N/A	N/A
nine mile	6/28/2006 9:32	18.42	65.16	1.4029	8.97	7.78	put glove on sonde	N/A	good	good	N/A	N/A
nine mile	7/6/2006 9:14	16.82	62.28	1.5153	8.46	8.03	changed DO membrane and calibrated @ office	small amount in tube	good	good	N/A	N/A
nine mile	7/7/2006 10:57	17.86	64.15	1.621	8.93	8.41	redeployed sonde	N/A	good	good	N/A	N/A
nine mile	7/13/2006 10:11	20.4	68.72	1.279	-1	8.23	sonde almost buried (90%), installed float on 7-14; DO charge below 25 so DO reading not accurate	probes covered in sediment	good	good	N/A	N/A
nine mile	7/20/2006 10:14	23.36	74.05	1.561	-1	8.25	sonde was not in water, changed battery; DO charge below 25 so DO reading not accurate; changed DO membrane	none	good	DO dried out	sunny	low
nine mile	8/1/2006 9:09	23.84	74.91	1.391	-1	8.46	sonde was not in water, DO charge below 25 so DO reading not accurate; changed DO membrane; algae on rocks	none	good	DO dried out	sunny, 90F, humid	low
nine mile	8/8/2006 9:22	22.8	73.04	1.448	7.52	8.29	? was not in water; changed DO membrane; algae on	none	good	DO dried out	sunny 80F	low
nine mile	8/9/2006 12:17	22.03	71.65	1.491	9.1	7.76	sonde redeployed and put on a new float	NA	good	good	sunny 85F	low
nine mile	8/16/2006 9:48	20.02	71.65	1.133	7.53	8.17	algae growth on rocks	none	good	good	sunny 80F	low
nine mile	8/28/2006 10:29	23.11	71.65	0.606	8.09	8.35	sonde was out of water b/c of where it landed after high flow; algae on probes	none	good	good	overcast 75F	low
nine mile	9/7/2006 9:28	18.02	71.65	1.342	9.53	8.1	pulled for maintenance					
nine mile	9/8/2006 12:59	19.94	71.65	1.387	10.11	8.04	sonde redeployed					
nine mile	9/15/2006 10:38	19.09	71.65	1.341	8.02	7.95	sonde out of water					
nine mile	9/20/2006 9:58	16.52	71.65	1.168	8.98	8.74	sonde ok					
nine mile	9/27/2006 9:44	15.89	71.65	1.401	10.24	7.99						

QA/QC reading not accurate; don't use

Saw Mill Run 1 - QA/QC Data

Site	QA/QC Date Time	Temp C	Temp F	Cond	DO	pH	Notes	Sediment	Probes	DO Membrame	Weather	Flow
SM1	6/1/2006 13:33	21.94	71.49	1.2676	8.75	7.88	redeployed sonde	N/A	good	good	N/A	N/A
SM1	6/9/2006 13:21	20.64	69.15	1.2452	9.41	8.06	-	some sediment in tube	good	good	N/A	N/A
SM1	6/20/2006 12:33	21.48	70.66	0.7848	9.07	7.92	-	small amount in tube	good	good	N/A	N/A
SM1	6/28/2006 12:45	22.13	71.83	1.1685	9.26	7.98	glove was put on sonde	small amount in tube	good	good	N/A	N/A
SM1	7/6/2006 11:11	18.57	65.43	1.2972	6.91	7.83	glove was gone, calibrated and changed DO membrames @ office	tube filled with sediment	good	good	N/A	N/A
SM1	7/7/2006 13:51	21.58	70.84	1.4034	8.42	7.85	redeployed sonde	N/A	good	good	N/A	N/A
SM1	7/14/2006 12:30	23.13	73.63	1.339	-1	7.49	installed milk jug float; DO charge below 25 so reading not accurate	small amount in tube	good	good	N/A	N/A
SM1	7/20/2006 13:00	25.8	78.44	1.362	-1	8.06	sonde propped up on a rock but probes still under water, changed batteries; DO charge below 25 so reading not accurate	none	good	good	sunny	low
SM1	8/1/2006 12:38	26.2	79.16	1.283	-1	7.85	glove ripped; float was gone so replaced with 3 small floats; DO charge below 25 so reading not accurate; algae growing on rocks	sediment in pipe but not blocking probes	good	good	sunny 90F humid	low
SM1	8/8/2006 12:22	25.67	78.21	1.297	9.49	7.95	algae on rocks; changed batteries; pulled sonde out for maintenance	none	good	good	sunny 80F	low
SM1	8/9/2006 14:35	24.66	76.39	1.373	9.79	7.74	redeployed sonde	NA	good	good	sunny 85F	low
SM1	8/16/2006 13:15	23.01	73.42	1.076	7.74	7.74	float gone; sediment in pipe but not blocking probes; algal growth on rocks; put new float on 8/21/06	sediment in pipe but not blocking probes	good	good	sunny 80F	low
SM1	8/28/2006 13:51	23.44	74.19	0.792	8.09	8.04	float missing; replaced with milk jug float	sediment in pipe probably blocking probes	good	good	overcast 75F	low
SM1	9/7/2006 12:15	20.14	68.25	1.206	9.87	8.01	pulled sonde for maintenance					
SM1	9/8/2006 13:42	21.25	70.25	1.279	10.35	8.36	redeployed sonde					
SM1	9/15/2006 13:24	20.02	68.04	0.726	5.97	7.88	sonde ok					
SM1	9/27/2006 13:02	18.48	65.26	1.318	11.14	8.14						

QA/QC reading not accurate; don't use

Saw Mill Run 2 - QA/QC Data

Site	QA/QC Date Time	Temp C	Temp F	Cond	DO	pH	Notes	Probes	DO Membrame	Weather	Flow
SM2	6/1/2006 12:36	15.75	60.35	1.4445	9.77	6.62					
SM2	6/9/2006 12:16	14.95	58.91	1.4943	10.66	6.97	sediment in tube				
SM2	6/20/2006 11:24	15.27	59.49	1.5349	10.08	7.15	no sediment in tube				
SM2	6/28/2006 11:38	15.31	59.56	1.6413	9.92	7.26	put glove on sonde; a lot of sediment in tube				
SM2	7/6/2006 10:47	14.77	58.59	1.6812	7.47	7.61	pulled out for maintenance				
SM2	7/7/2006 12:49	15.37	59.67	1.7107	9.63	7.98	redeployed sonde	N/A	good	N/A	N/A
SM2	7/14/2006 11:13	15.36	59.65	1.683	-1	7.75	installed milk jug float; DO charge below 25 so reading not accurate	none	good	N/A	N/A
SM2	7/20/2006 11:51	15.59	60.06	1.672	-1	7.82	changed batteries; DO charge below 25 so reading not accurate	none	good	sunny	normal height
SM2	8/1/2006 11:24	15.73	60.31	1.653	-1	7.88	glove ripped and float gone; installed another milk jug float; DO charge below 25 so reading not accurate	packed with sediment, probes blocked	good	sunny 90F humid	normal height
SM2	8/8/2006 10:41	27.09	80.76	0.727	8.27	7.37	pulled sonde for maintenance	none	good	sunny 80F	low
SM2	8/9/2006 13:32	15.53	59.95	1.662	10.2	7.47	redeployed sonde	NA	good	sunny 85F	low
SM2	8/16/2006 11:35	15.17	59.31	1.636	10.37	7.7		none	good	sunny 80F	low
SM2	8/28/2006 12:16	15.16	59.29	1.512	10.39	7.83		none	good	overcast 75F	low
SM2	9/7/2006 10:47	14.61	58.30	1.632	10.71	8.05	pulled sonde for maintenance				
SM2	9/8/2006 11:25	14.93	58.87	1.625	9.53	7.98	redeployed sonde				
SM2	9/15/2006 11:48	14.93	58.87	1.583	9.64	7.85	sonde out of water	none	good		
SM2	9/27/2006 11:08	14.37	57.87	1.619	10.19	8.09	sonde out of water	none	good		

QA/QC reading not accurate; don't use

Streets Run 1 - QA/QC Data

Site	QA/QC Date Time	Temp C	Temp F	Cond	DO	pH	Notes	Sediment	Probes	DO Membrame	Weather	Flow
SR1	6/1/2006 11:40	20.34	68.61	1.1978	9.29	8.1	redeployed sonde	N/A	good	good	N/A	N/A
SR1	6/9/2006 10:55	17.56	63.61	1.0744	10.2	8.1	-	probes were covered	good	good	N/A	N/A
SR1	6/20/2006 10:19	18.88	65.98	0.8665	8.95	7.97	-	N/A	good	good	N/A	N/A
SR1	6/28/2006 10:32	19.41	66.94	1.0658	9.25	8.02	put gloves on sonde	N/A	good	good	N/A	N/A
SR1	7/6/2006 10:03	17.6	63.68	1.1583	9.49	8.11	changed DO membrame and calibrated @ office	some sediment in tube but probes not blocked	good	good	N/A	N/A
SR1	7/7/2006 11:45	18.59	65.46	1.2273	8.95	8.1	redeployed sonde	N/A	good	good	N/A	N/A
SR1	7/14/2006 10:18	20.63	69.13	1.186	-1	7.96	DO charge below 25 so reading not accurate	some sediment in tube but probes not blocked	good	good	N/A	N/A
SR1	7/20/2006 11:03	22.87	73.17	1.227	-1	8.3	changed batteries; DO charge below 25 so reading not accurate	none	good	good	sunny	N/A
SR1	8/1/2006 9:59	23	73.40	1.106	-1	8.1	water was silty; glove on pipe gone; DO charge below 25 so reading not accurate	some sediment in tube but probles not blocked	good	good	sunny, 90F humid	a little higher than normal
SR1	8/8/2006 10:00	22.45	72.41	1.181	8.39	8.33	pulled sonde for maintenance	none	good	good	sunny 80F	normal
SR1	8/9/2006 12:54	26.21	79.18	1.06	8.21	7.89	redeployed sonde	NA	good	good	sunny 85F	normal
SR1	8/16/2006 10:31	19.78	67.60	1.138	9.36	8.02	-	none	good	good	sunny 80F	low
SR1	8/28/2006 11:30	22.42	72.36	0.987	8.91	8.27	-	none	good	good	overcast 75F	normal
SR1	9/7/2006 10:09	17.29	63.12	1.236	10.37	8.23	pulled sonde for maintenance	-	-	-	-	-

QA/QC reading not accurate; don't use

ATTACHMENT G
DRY WEATHER DATA TABLES

Becks Run 1 - Dry Weather Data

Becks Run	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
6/8/2006	9.20	8.76	0.44	9.66	6/7/06 9:15
6/9/2006	9.31	9.00	0.31	9.69	6/7/06 9:15
6/10/2006	9.76	9.30	0.46	10.30	6/7/06 9:15
6/11/2006	10.22	9.62	0.60	10.95	6/7/06 9:15
6/12/2006	10.32	9.40	0.92	11.11	6/7/06 9:15
6/13/2006	10.05	9.05	1.00	10.94	6/7/06 9:15
6/14/2006	9.82	8.68	1.14	10.91	6/7/06 9:15
6/15/2006	9.91	8.95	0.96	11.06	6/7/06 9:15
6/16/2006	9.91	8.66	1.25	11.30	6/7/06 9:15
6/17/2006	9.61	8.33	1.28	10.91	6/7/06 9:15
6/18/2006	9.33	7.88	1.45	10.67	6/7/06 9:15

Minimum Daily Avg DO for Month:	9.20
Minimum DO for Month:	7.88
Average of Daily Diurnal DO for Month:	0.89
Minimum Daily Diurnal Variation for Month:	0.31
Maximum Daily Diurnal Variation for Month:	1.45
Maximum DO for Month:	11.30

Becks Run	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
7/8/2006	8.23	7.97	0.26	8.54	7/5/06 6:00
7/9/2006	8.30	8.07	0.24	8.58	7/5/06 6:00
7/10/2006	8.32	7.95	0.37	8.66	7/5/06 6:00
7/11/2006	8.29	7.78	0.51	8.69	7/5/06 6:00
7/14/2006	8.02	7.83	0.20	8.22	7/13/06 8:00
7/15/2006	8.03	7.82	0.21	8.22	7/13/06 8:00
7/16/2006	8.13	7.82	0.30	8.72	7/13/06 8:00
7/17/2006	7.94	7.41	0.53	8.45	7/13/06 8:00
7/18/2006	7.81	7.55	0.26	8.23	7/13/06 8:00
7/19/2006	7.85	7.47	0.37	8.15	7/13/06 8:00
7/20/2006	7.91	7.38	0.53	8.36	7/13/06 8:00
7/23/2006	8.11	7.78	0.33	8.56	7/22/06 19:00
7/24/2006	8.19	7.79	0.39	8.63	7/22/06 19:00
7/25/2006	8.02	7.55	0.48	8.50	7/22/06 19:00
7/26/2006	7.91	7.39	0.53	8.35	7/22/06 19:00

Minimum Daily Avg DO for Month:	7.81
Minimum DO for Month:	7.38
Average of Daily Diurnal DO for Month:	0.37
Minimum Daily Diurnal Variation for Month:	0.20
Maximum Daily Diurnal Variation for Month:	0.53
Maximum DO for Month:	8.72

Becks Run 1 - Dry Weather Data

Becks Run	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
8/1/2006	7.12	6.78	0.34	7.46	7/30/06 22:00
8/2/2006	7.00	6.67	0.34	7.23	7/30/06 22:00
8/5/2006	7.37	6.96	0.41	7.78	8/4/06 4:30
8/6/2006	7.35	6.76	0.59	8.06	8/4/06 4:30
8/7/2006	7.14	6.45	0.69	7.73	8/4/06 4:30
8/8/2006	6.91	6.65	0.27	7.52	8/4/06 4:30
8/17/2006	7.77	7.11	0.66	8.45	8/15/06 2:30
8/18/2006	7.79	7.19	0.59	8.42	8/15/06 2:30
8/21/2006	7.80	7.32	0.48	8.11	8/19/06 18:45
8/22/2006	8.00	7.48	0.52	8.40	8/19/06 18:45
8/23/2006	8.21	7.81	0.40	8.51	8/19/06 18:45
8/24/2006	8.43	8.20	0.23	8.66	8/19/06 18:45
8/25/2006	8.49	8.19	0.29	8.84	8/19/06 18:45
8/26/2006	8.58	8.28	0.30	8.92	8/19/06 18:45
8/30/2006	8.85	8.59	0.27	9.00	8/29/06 12:15
8/31/2006	8.11	6.42	1.68	10.44	8/29/06 12:15

Minimum Daily Avg DO for Month:	6.91
Minimum DO for Month:	6.42
Average of Daily Diurnal DO for Month:	0.50
Minimum Daily Diurnal Variation for Month:	0.23
Maximum Daily Diurnal Variation for Month:	1.68
Maximum DO for Month:	10.44

Becks Run	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
9/9/2006	8.92	8.43	0.49	9.33	9/6/06 4:30
9/10/2006	9.04	8.53	0.51	9.56	9/6/06 4:30
9/11/2006	9.10	8.58	0.52	9.62	9/6/06 4:30
9/16/2006	9.18	8.99	0.19	9.37	9/15/06 1:45
9/18/2006	9.32	8.89	0.43	9.72	9/17/06 7:30
9/20/2006	10.24	9.72	0.52	10.61	9/19/06 4:15
9/21/2006	10.79	10.44	0.35	11.14	9/19/06 4:15
9/22/2006	10.87	10.30	0.57	11.34	9/19/06 4:15
9/25/2006	10.65	9.44	1.21	11.25	9/24/06 11:45
9/26/2006	10.98	9.84	1.14	11.62	9/24/06 11:45
9/27/2006	9.57	8.19	1.38	11.49	9/24/06 11:45

Minimum Daily Avg DO for Month:	8.92
Minimum DO for Month:	8.19
Average of Daily Diurnal DO for Month:	0.66
Minimum Daily Diurnal Variation for Month:	0.19
Maximum Daily Diurnal Variation for Month:	1.38
Maximum DO for Month:	11.62

Chartiers Creek 1 - Dry Weather Data

Chartiers Creek 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
06/10/06	9.21	7.78	1.43	11.17	6/8/06 19:45
06/11/06	10.03	7.83	2.20	12.06	6/8/06 19:45
06/12/06	10.45	8.24	2.21	13.16	6/8/06 19:45
06/13/06	10.83	8.13	2.70	14.25	6/8/06 19:45
06/14/06	10.45	7.39	3.06	14.19	6/8/06 19:45
06/15/06	9.97	6.65	3.32	13.93	6/8/06 19:45
06/16/06	9.88	6.13	3.75	14.11	6/8/06 19:45
06/17/06	9.62	5.91	3.71	14.19	6/8/06 19:45

Minimum Daily Avg DO for Month:	9.21
Minimum DO for Month:	5.91
Average of Daily Diurnal DO for Month:	2.80
Minimum Daily Diurnal Variation for Month:	1.43
Maximum Daily Diurnal Variation for Month:	3.75
Maximum DO for Month:	14.25

Chartiers Creek 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
07/08/06	10.68	9.49	1.19	12.31	7/5/06 6:00
07/09/06	10.74	9.11	1.63	12.64	7/5/06 6:00
07/10/06	11.14	9.32	1.82	13.57	7/5/06 6:00
07/11/06	11.91	8.31	3.60	15.49	7/5/06 6:00
07/14/06	4.86	0.14	4.72	11.48	7/13/06 10:45
07/15/06	9.90	8.25	1.65	11.86	7/13/06 10:45
07/16/06	10.71	7.39	3.32	13.60	7/13/06 10:45
07/17/06	11.86	8.82	3.04	15.69	7/13/06 10:45
07/18/06	12.68	8.69	3.99	16.95	7/13/06 10:45
07/19/06	13.62	9.48	4.14	18.16	7/13/06 10:45
07/20/06	13.34	10.10	3.24	17.56	7/13/06 10:45
07/23/06	10.88	7.56	3.32	15.42	7/22/06 18:45
07/24/06	10.65	4.58	6.07	15.08	7/22/06 18:45
07/25/06	11.11	6.91	4.20	15.96	7/22/06 18:45
07/26/06	9.54	5.24	4.30	13.01	7/22/06 18:45

Minimum Daily Avg DO for Month:	4.86
Minimum DO for Month:	0.14
Average of Daily Diurnal DO for Month:	3.35
Minimum Daily Diurnal Variation for Month:	1.19
Maximum Daily Diurnal Variation for Month:	6.07
Maximum DO for Month:	18.16

Chartiers Creek 1 - Dry Weather Data

Chartiers Creek 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
08/05/06	10.35	7.89	2.46	13.94	8/4/06 4:30
08/06/06	10.85	8.46	2.39	14.48	8/4/06 4:30
08/07/06	10.94	8.14	2.80	14.52	8/4/06 4:30
08/10/06	9.25	7.68	1.58	10.83	8/4/06 4:30
08/11/06	9.51	6.49	3.02	11.28	8/4/06 4:30
08/12/06	10.05	7.62	2.43	11.62	8/4/06 4:30
08/13/06	10.47	8.70	1.76	11.94	8/4/06 4:30

Minimum Daily Avg DO for Month:	9.25
Minimum DO for Month:	6.49
Average of Daily Diurnal DO for Month:	2.35
Minimum Daily Diurnal Variation for Month:	1.58
Maximum Daily Diurnal Variation for Month:	3.02
Maximum DO for Month:	14.52

Chartiers Creek 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
09/09/06	9.30	7.68	1.63	11.76	9/5/06 7:45
09/10/06	9.04	7.58	1.47	11.47	9/5/06 7:45
09/11/06	9.27	7.54	1.73	11.65	9/5/06 7:45
09/17/06	8.98	7.71	1.27	10.63	9/14/06 20:30
09/20/06	9.33	7.66	1.67	11.59	9/19/06 4:45
09/21/06	10.46	9.18	1.28	13.15	9/19/06 4:45
09/22/06	10.93	9.50	1.42	13.43	9/19/06 4:45
09/26/06	10.58	9.11	1.46	13.17	9/25/06 15:15

Minimum Daily Avg DO for Month:	8.98
Minimum DO for Month:	7.54
Average of Daily Diurnal DO for Month:	1.49
Minimum Daily Diurnal Variation for Month:	1.27
Maximum Daily Diurnal Variation for Month:	1.73
Maximum DO for Month:	13.43

Chartiers Creek 2 - Dry Weather Data

Chartiers Creek 2	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
6/10/06	9.30	6.89	2.41	10.95	6/8/06 17:15
6/11/06	9.38	6.67	2.71	11.93	6/8/06 17:15
6/12/06	10.46	8.91	1.55	12.53	6/8/06 17:15
6/13/06	10.59	8.47	2.12	13.63	6/8/06 17:15
6/14/06	10.21	8.31	1.90	12.84	6/8/06 17:15
6/15/06	10.24	8.17	2.07	13.40	6/8/06 17:15
6/16/06	10.28	7.89	2.39	13.71	6/8/06 17:15
6/17/06	9.95	7.57	2.38	13.39	6/8/06 17:15
6/18/06	9.61	7.41	2.20	12.96	6/8/06 17:15

Minimum Daily Avg DO for Month:	9.30
Minimum DO for Month:	6.67
Average of Daily Diurnal DO for Month:	2.19
Minimum Daily Diurnal Variation for Month:	1.55
Maximum Daily Diurnal Variation for Month:	2.71
Maximum DO for Month:	13.71

Chartiers Creek 2	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
7/8/06	6.75	5.72	1.03	7.96	7/5/06 6:00
7/9/06	6.95	5.68	1.27	8.89	7/5/06 6:00
7/10/06	7.00	5.60	1.40	9.47	7/5/06 6:00
7/11/06	7.46	5.24	2.22	10.96	7/5/06 6:00
7/15/06	6.65	5.37	1.28	8.92	7/13/06 10:45
7/16/06	6.75	4.03	2.72	9.55	7/13/06 10:45
7/17/06	5.50	2.56	2.94	8.77	7/13/06 10:45

Minimum Daily Avg DO for Month:	5.50
Minimum DO for Month:	2.56
Average of Daily Diurnal DO for Month:	1.84
Minimum Daily Diurnal Variation for Month:	1.03
Maximum Daily Diurnal Variation for Month:	2.94
Maximum DO for Month:	10.96

Chartiers Creek 2 - Dry Weather Data

Chartiers Creek 2	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
8/2/06	7.46	5.88	1.57	9.85	7/31/06 11:45
8/5/06	8.44	5.77	2.67	12.03	8/4/06 4:30
8/6/06	8.92	4.69	4.23	14.21	8/4/06 4:30
8/7/06	8.60	5.85	2.75	12.89	8/4/06 4:30
8/8/06	7.28	5.96	1.32	11.60	8/4/06 4:30
8/10/06	7.72	6.28	1.44	10.03	8/4/06 4:30
8/11/06	6.08	4.10	1.98	7.15	8/4/06 4:30
8/12/06	6.82	3.96	2.86	9.93	8/4/06 4:30
8/17/06	8.40	7.38	1.02	9.79	8/15/06 1:30
8/18/06	8.43	7.29	1.14	10.15	8/15/06 1:30

Minimum Daily Avg DO for Month:	6.08
Minimum DO for Month:	3.96
Average of Daily Diurnal DO for Month:	2.10
Minimum Daily Diurnal Variation for Month:	1.02
Maximum Daily Diurnal Variation for Month:	4.23
Maximum DO for Month:	14.21

Chartiers Creek 2	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
09/09/06	9.69	7.37	2.32	13.49	9/5/06 7:45
09/10/06	9.48	7.36	2.12	13.22	9/5/06 7:45
09/11/06	9.26	7.12	2.14	12.59	9/5/06 7:45
09/17/06	8.76	7.79	0.97	10.31	9/14/06 20:30
09/20/06	9.17	7.49	1.68	11.80	9/19/06 4:45
09/21/06	10.07	8.28	1.79	12.89	9/19/06 4:45
09/22/06	9.94	8.30	1.64	12.75	9/19/06 4:45
09/26/06	9.60	7.72	1.88	12.97	9/25/06 15:15
09/27/06	9.81	7.89	1.92	13.15	9/25/06 15:15

Minimum Daily Avg DO for Month:	8.76
Minimum DO for Month:	7.12
Average of Daily Diurnal DO for Month:	1.83
Minimum Daily Diurnal Variation for Month:	0.97
Maximum Daily Diurnal Variation for Month:	2.32
Maximum DO for Month:	13.49

Nine Mile Run 1 - Dry Weather Data

Nine Mile Run	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
6/10/06	8.52	7.72	0.80	9.35	6/8/06 17:15
6/11/06	8.96	8.10	0.86	9.88	6/8/06 17:15
6/12/06	9.04	7.88	1.16	9.97	6/8/06 17:15
6/13/06	8.68	7.60	1.08	9.92	6/8/06 17:15
6/14/06	8.71	7.59	1.12	10.39	6/8/06 17:15
6/15/06	8.70	7.38	1.32	10.44	6/8/06 17:15
6/16/06	8.37	6.94	1.43	10.02	6/8/06 17:15
6/17/06	8.39	6.95	1.44	10.70	6/8/06 17:15
6/18/06	8.40	6.61	1.79	10.81	6/8/06 17:15

Minimum Daily Avg DO for Month:	8.37
Minimum DO for Month:	6.61
Average of Daily Diurnal DO for Month:	1.22
Minimum Daily Diurnal Variation for Month:	0.80
Maximum Daily Diurnal Variation for Month:	1.79
Maximum DO for Month:	10.81

Nine Mile Run	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
7/1/06	8.44	7.33	1.11	9.38	6/29/06 15:00
7/2/06	8.25	7.02	1.23	9.80	6/29/06 15:00
7/8/06	7.92	6.84	1.07	9.15	7/5/06 6:00
7/9/06	7.95	6.85	1.10	9.45	7/5/06 6:00
7/10/06	7.91	7.01	0.89	9.55	7/5/06 6:00
7/14/06	7.47	6.89	0.58	8.17	7/13/06 9:15
7/15/06	7.66	6.95	0.71	8.54	7/13/06 9:15
7/16/06	7.72	6.88	0.84	8.51	7/13/06 9:15
7/17/06	7.50	6.58	0.92	8.55	7/13/06 9:15
7/18/06	7.57	6.61	0.96	9.05	7/13/06 9:15

Minimum Daily Avg DO for Month:	7.47
Minimum DO for Month:	6.58
Average of Daily Diurnal DO for Month:	0.94
Minimum Daily Diurnal Variation for Month:	0.58
Maximum Daily Diurnal Variation for Month:	1.23
Maximum DO for Month:	9.80

Nine Mile Run 1 - Dry Weather Data

Nine Mile Run	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
8/11/06	6.68	5.48	1.20	8.59	8/4/06 4:30
8/12/06	7.14	6.08	1.06	8.96	8/4/06 4:30
8/13/06	7.68	6.68	1.00	9.24	8/4/06 4:30

Minimum Daily Avg DO for Month:	6.68
Minimum DO for Month:	5.48
Average of Daily Diurnal DO for Month:	1.09
Minimum Daily Diurnal Variation for Month:	1.00
Maximum Daily Diurnal Variation for Month:	1.20
Maximum DO for Month:	9.24

Nine Mile Run	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
09/09/06	9.10	7.94	1.16	11.36	9/6/06 5:00
09/10/06	9.35	7.84	1.51	11.62	9/6/06 5:00
09/11/06	9.25	7.89	1.36	11.84	9/6/06 5:00
09/16/06	8.09	7.76	0.33	8.52	9/15/06 18:30
09/17/06	8.05	7.64	0.41	8.67	9/15/06 18:30
09/18/06	8.23	7.53	0.70	9.28	9/15/06 18:30
09/21/06	9.47	8.64	0.83	11.27	9/19/06 4:45
09/22/06	9.85	8.51	1.34	12.18	9/19/06 4:45

Minimum Daily Avg DO for Month:	8.05
Minimum DO for Month:	7.53
Average of Daily Diurnal DO for Month:	0.96
Minimum Daily Diurnal Variation for Month:	0.33
Maximum Daily Diurnal Variation for Month:	1.51
Maximum DO for Month:	12.18

Saw Mill Run 1 - Dry Weather Data

Saw Mill Run 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
06/10/06	8.98	8.25	0.73	9.88	6/7/06 9:15
06/11/06	9.39	8.59	0.80	10.39	6/7/06 9:15
06/12/06	9.41	8.47	0.94	10.42	6/7/06 9:15
06/13/06	9.11	8.02	1.09	10.28	6/7/06 9:15
06/14/06	8.83	7.87	0.96	10.17	6/7/06 9:15
06/15/06	8.85	7.80	1.05	10.25	6/7/06 9:15
06/16/06	8.85	7.69	1.16	10.34	6/7/06 9:15
06/17/06	8.62	7.39	1.23	10.22	6/7/06 9:15
06/18/06	8.56	6.93	1.63	10.42	6/7/06 9:15

Minimum Daily Avg DO for Month:	8.56
Minimum DO for Month:	6.93
Average of Daily Diurnal DO for Month:	1.07
Minimum Daily Diurnal Variation for Month:	0.73
Maximum Daily Diurnal Variation for Month:	1.63
Maximum DO for Month:	10.42

Saw Mill Run 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
07/08/06	8.07	7.39	0.68	8.72	7/5/06 6:00
07/09/06	8.07	7.37	0.70	8.81	7/5/06 6:00
07/10/06	8.03	7.27	0.76	9.02	7/5/06 6:00
07/15/06	7.37	6.81	0.56	8.29	7/13/06 8:00
07/16/06	7.51	6.66	0.86	8.49	7/13/06 8:00
07/17/06	7.48	6.48	1.00	8.73	7/13/06 8:00
07/18/06	7.66	6.58	1.08	9.16	7/13/06 8:00
07/19/06	7.65	6.50	1.15	9.07	7/13/06 8:00
07/20/06	7.74	6.43	1.31	10.01	7/13/06 8:00
07/23/06	6.04	4.91	1.13	7.30	7/22/06 18:30
07/24/06	6.08	4.72	1.35	7.36	7/22/06 18:30
07/25/06	6.20	3.63	2.57	8.64	7/22/06 18:30
07/26/06	7.55	6.20	1.35	9.39	7/22/06 18:30

Minimum Daily Avg DO for Month:	6.04
Minimum DO for Month:	3.63
Average of Daily Diurnal DO for Month:	1.12
Minimum Daily Diurnal Variation for Month:	0.56
Maximum Daily Diurnal Variation for Month:	2.57
Maximum DO for Month:	10.01

Saw Mill Run 1 - Dry Weather Data

Saw Mill Run 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
08/02/06	6.99	6.44	0.55	7.55	7/28/06 10:30
08/05/06	7.83	6.84	0.99	9.56	8/4/06 4:15
08/06/06	8.28	6.61	1.66	10.48	8/4/06 4:15
08/07/06	7.88	6.38	1.50	10.31	8/4/06 4:15
08/10/06	8.01	7.12	0.89	9.34	8/4/06 4:15
08/11/06	7.96	7.20	0.76	9.03	8/4/06 4:15
08/12/06	8.11	7.38	0.73	9.06	8/4/06 4:15
08/13/06	8.36	7.61	0.75	9.33	8/4/06 4:15
08/17/06	8.17	7.45	0.72	8.99	8/15/06 2:00
08/18/06	8.15	7.37	0.78	9.18	8/15/06 2:00
08/22/06	8.52	8.02	0.50	8.85	8/19/06 19:45
08/23/06	8.57	8.18	0.39	8.82	8/19/06 19:45
08/24/06	8.68	8.58	0.10	8.85	8/19/06 19:45
08/25/06	8.59	7.40	1.19	9.29	8/19/06 19:45
08/26/06	8.26	7.34	0.92	9.50	8/19/06 19:45

Minimum Daily Avg DO for Month:	6.99
Minimum DO for Month:	6.38
Average of Daily Diurnal DO for Month:	0.83
Minimum Daily Diurnal Variation for Month:	0.10
Maximum Daily Diurnal Variation for Month:	1.66
Maximum DO for Month:	10.48

Saw Mill Run 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
09/09/06	8.98	7.93	1.05	10.61	9/6/06 4:30
09/10/06	9.04	7.92	1.12	10.86	9/6/06 4:30
09/11/06	9.07	7.88	1.19	11.14	9/6/06 4:30
09/18/06	8.47	7.58	0.89	9.50	9/17/06 7:30
09/20/06	9.10	7.84	1.26	10.50	9/19/06 4:15
09/21/06	9.70	9.10	0.60	10.69	9/19/06 4:15
09/22/06	9.82	8.73	1.09	11.10	9/19/06 4:15
09/25/06	9.27	8.50	0.77	10.86	9/24/06 11:45
09/26/06	9.63	8.78	0.85	11.15	9/24/06 11:45
09/27/06	9.55	8.52	1.03	11.17	9/24/06 11:45

Minimum Daily Avg DO for Month:	8.47
Minimum DO for Month:	7.58
Average of Daily Diurnal DO for Month:	0.99
Minimum Daily Diurnal Variation for Month:	0.60
Maximum Daily Diurnal Variation for Month:	1.26
Maximum DO for Month:	11.17

Saw Mill Run 2 - Dry Weather Data

Saw Mill Run 2	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
06/21/06	10.26	9.95	0.31	10.50	6/19/06 23:45
06/30/06	9.96	9.44	0.52	10.38	6/29/06 16:00

Minimum Daily Avg DO for Month:	9.96
Minimum DO for Month:	9.44
Average of Daily Diurnal DO for Month:	0.42
Minimum Daily Diurnal Variation for Month:	0.31
Maximum Daily Diurnal Variation for Month:	0.52
Maximum DO for Month:	10.50

Saw Mill Run 2	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
07/08/06	8.83	8.57	0.26	9.12	7/5/06 6:00
07/15/06	7.88	7.48	0.40	8.29	7/13/06 8:00
07/26/06	8.42	8.17	0.25	8.66	7/22/06 18:30
07/29/06	8.30	8.00	0.30	8.53	7/28/06 10:30

Minimum Daily Avg DO for Month:	7.88
Minimum DO for Month:	7.48
Average of Daily Diurnal DO for Month:	0.30
Minimum Daily Diurnal Variation for Month:	0.25
Maximum Daily Diurnal Variation for Month:	0.40
Maximum DO for Month:	9.12

Saw Mill Run 2	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
08/02/06	8.20	7.91	0.29	8.51	7/30/06 21:45
08/05/06	8.08	7.31	0.77	8.99	8/4/06 4:15
08/10/06	5.47	5.28	0.19	5.55	8/4/06 4:15
08/11/06	5.66	5.32	0.34	6.01	8/4/06 4:15
08/12/06	5.31	5.00	0.31	5.66	8/4/06 4:15
08/13/06	4.97	4.43	0.54	5.33	8/4/06 4:15
08/17/06	6.07	5.86	0.21	6.28	8/15/06 2:00
08/18/06	5.88	5.67	0.21	6.06	8/15/06 2:00
08/21/06	5.54	4.76	0.78	5.97	8/19/06 19:45
08/22/06	5.89	5.71	0.18	6.05	8/19/06 19:45
08/23/06	5.70	5.38	0.32	5.95	8/19/06 19:45
08/24/06	4.86	4.40	0.46	5.38	8/19/06 19:45
08/25/06	5.21	4.24	0.97	5.87	8/19/06 19:45
08/26/06	5.82	5.63	0.19	5.99	8/19/06 19:45
08/30/06	4.91	4.39	0.52	5.49	8/29/06 6:30
08/31/06	4.35	3.99	0.36	4.63	8/29/06 6:30

Minimum Daily Avg DO for Month:	4.35
Minimum DO for Month:	3.99
Average of Daily Diurnal DO for Month:	0.42
Minimum Daily Diurnal Variation for Month:	0.18
Maximum Daily Diurnal Variation for Month:	0.97
Maximum DO for Month:	8.99

Saw Mill Run 2	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
09/03/06	5.10	4.53	0.57	5.60	9/2/06 21:00
09/09/06	9.05	8.77	0.28	9.27	9/6/06 4:30
09/10/06	9.06	8.70	0.36	9.40	9/6/06 4:30
09/16/06	9.32	9.08	0.24	9.50	9/15/06 1:45
09/21/06	9.32	8.94	0.38	9.58	9/19/06 4:15
09/27/06	9.45	9.15	0.30	9.74	9/24/06 11:45

Minimum Daily Avg DO for Month:	5.10
Minimum DO for Month:	4.53
Average of Daily Diurnal DO for Month:	0.36
Minimum Daily Diurnal Variation for Month:	0.24
Maximum Daily Diurnal Variation for Month:	0.57
Maximum DO for Month:	9.74

Streets Run 1 - Dry Weather Data

Streets Run 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
6/8/2006	8.83	8.15	0.68	9.39	6/7/06 9:15
6/9/2006	9.09	8.63	0.46	9.77	6/7/06 9:15
6/10/2006	9.72	9.34	0.38	10.26	6/7/06 9:15
6/11/2006	10.21	9.76	0.45	10.86	6/7/06 9:15
6/12/2006	10.28	9.76	0.52	10.90	6/7/06 9:15
6/13/2006	10.00	9.29	0.71	10.76	6/7/06 9:15
6/14/2006	9.82	9.24	0.58	10.47	6/7/06 9:15
6/15/2006	9.54	9.50	0.04	9.58	6/7/06 9:15
6/16/2006	9.88	9.17	0.71	10.70	6/7/06 9:15
6/17/2006	9.71	8.81	0.90	10.50	6/7/06 9:15
6/18/2006	9.48	8.50	0.98	10.37	6/7/06 9:15

Minimum Daily Avg DO for Month:	8.83
Minimum DO for Month:	8.15
Average of Daily Diurnal DO for Month:	0.58
Minimum Daily Diurnal Variation for Month:	0.04
Maximum Daily Diurnal Variation for Month:	0.98
Maximum DO for Month:	10.90

Streets Run 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
7/8/2006	7.57	7.11	0.46	7.90	7/5/06 6:15
7/9/2006	7.45	7.18	0.27	7.84	7/5/06 6:15
7/10/2006	7.30	6.89	0.41	7.64	7/5/06 6:15
7/11/2006	7.03	6.52	0.52	7.49	7/5/06 6:15
7/15/2006	7.94	7.62	0.32	8.40	7/13/06 8:00
7/16/2006	7.74	5.35	2.39	9.79	7/13/06 8:00
7/17/2006	7.11	6.64	0.47	7.54	7/13/06 8:00
7/18/2006	6.92	6.42	0.50	7.39	7/13/06 8:00
7/19/2006	6.88	6.40	0.48	7.42	7/13/06 8:00
7/20/2006	6.62	6.08	0.54	7.30	7/13/06 8:00
7/23/2006	6.79	6.50	0.28	7.28	7/22/06 15:45
7/24/2006	6.70	5.90	0.81	7.26	7/22/06 15:45
7/25/2006	6.61	6.03	0.58	7.12	7/22/06 15:45
7/26/2006	6.47	6.10	0.37	7.01	7/22/06 15:45

Minimum Daily Avg DO for Month:	6.47
Minimum DO for Month:	5.35
Average of Daily Diurnal DO for Month:	0.60
Minimum Daily Diurnal Variation for Month:	0.27
Maximum Daily Diurnal Variation for Month:	2.39
Maximum DO for Month:	9.79

Streets Run 1 - Dry Weather Data

Streets Run 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
8/1/2006	6.97	6.03	0.94	8.34	7/30/06 22:00
8/2/2006	7.61	7.04	0.57	8.14	7/30/06 22:00
8/5/2006	8.43	7.84	0.59	9.04	8/4/06 5:00
8/6/2006	8.60	7.65	0.95	9.51	8/4/06 5:00
8/7/2006	8.14	7.42	0.72	9.11	8/4/06 5:00
8/8/2006	7.98	7.71	0.27	8.39	8/4/06 5:00
8/10/2006	7.32	6.99	0.34	7.89	8/4/06 5:00
8/11/2006	7.60	7.22	0.38	8.16	8/4/06 5:00
8/12/2006	7.96	7.45	0.50	8.71	8/4/06 5:00
8/13/2006	8.28	7.79	0.49	9.18	8/4/06 5:00
8/17/2006	9.07	8.58	0.49	9.49	8/15/06 3:30
8/18/2006	8.98	8.62	0.36	9.39	8/15/06 3:30
8/21/2006	9.14	8.73	0.41	9.72	8/19/06 20:00
8/22/2006	9.13	8.54	0.59	9.68	8/19/06 20:00
8/23/2006	9.05	8.27	0.78	9.79	8/19/06 20:00
8/24/2006	9.03	8.63	0.40	9.74	8/19/06 20:00
8/25/2006	8.97	8.32	0.65	9.59	8/19/06 20:00
8/26/2006	8.91	8.19	0.72	9.75	8/19/06 20:00
8/30/2006	8.89	8.68	0.21	9.25	8/29/06 6:45
8/31/2006	9.15	8.94	0.21	9.49	8/29/06 6:45

Minimum Daily Avg DO for Month:	6.97
Minimum DO for Month:	6.03
Average of Daily Diurnal DO for Month:	0.53
Minimum Daily Diurnal Variation for Month:	0.21
Maximum Daily Diurnal Variation for Month:	0.95
Maximum DO for Month:	9.79

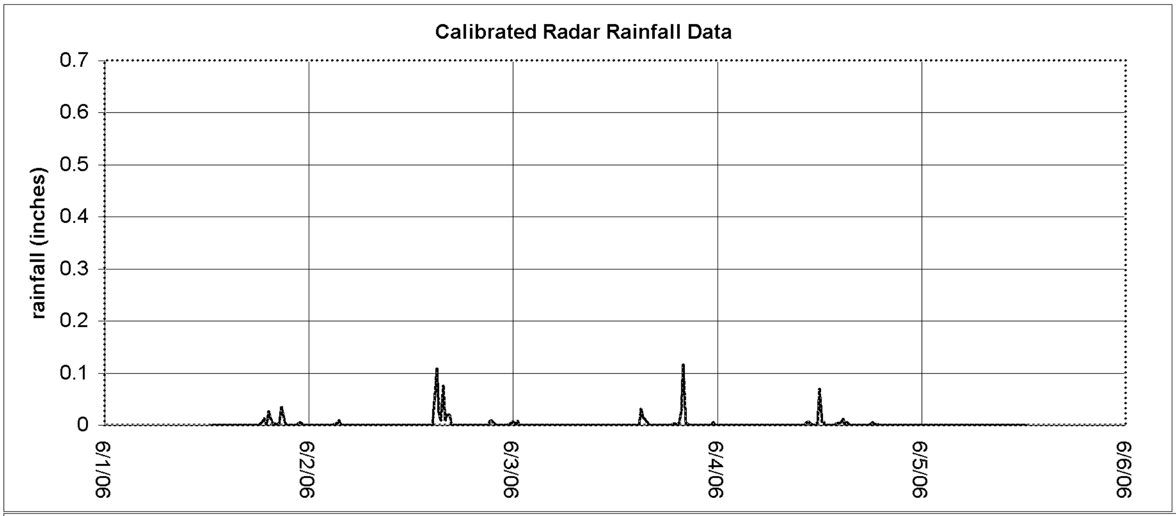
Streets Run 1	Avg. DO	Min DO	Diurnal DO	Max DO	Last Rain Date
09/03/06	9.83	9.58	0.25	10.10	9/2/06 21:00
09/04/06	9.82	9.35	0.47	10.30	9/2/06 21:00
09/07/06	9.97	9.73	0.24	10.28	9/6/06 4:30

Minimum Daily Avg DO for Month:	9.82
Minimum DO for Month:	9.35
Average of Daily Diurnal DO for Month:	0.32
Minimum Daily Diurnal Variation for Month:	0.24
Maximum Daily Diurnal Variation for Month:	0.47
Maximum DO for Month:	10.30

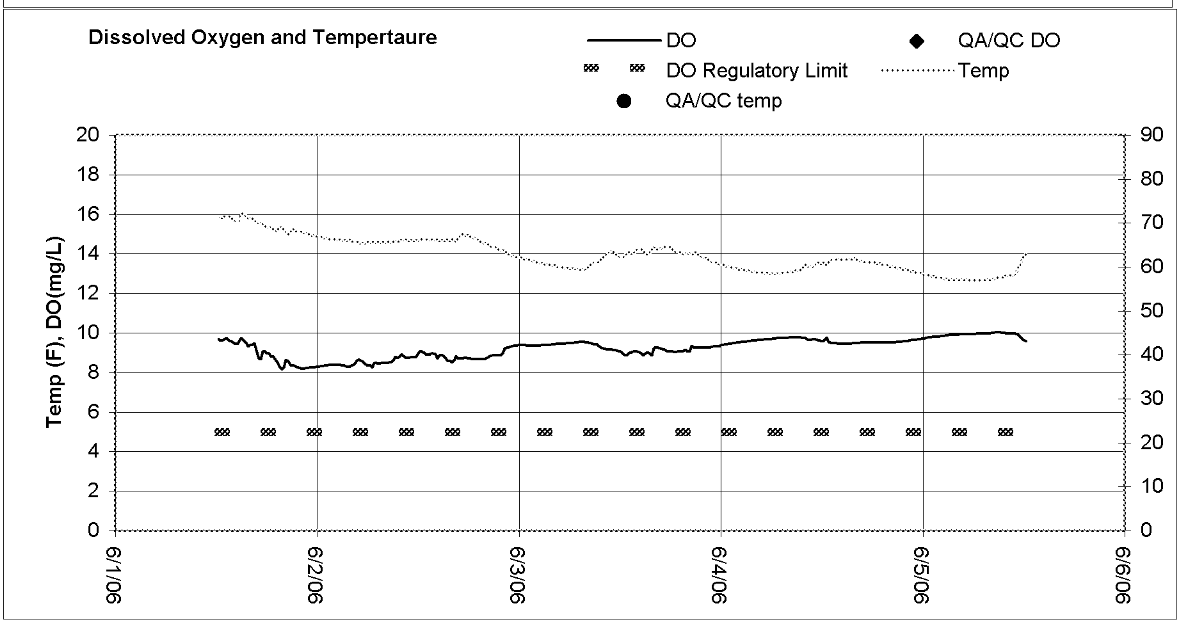
ATTACHMENT H
WET WEATHER DATA GRAPHS

BECKS RUN (BR-SW-1)
WET WEATHER DATA GRAPHS

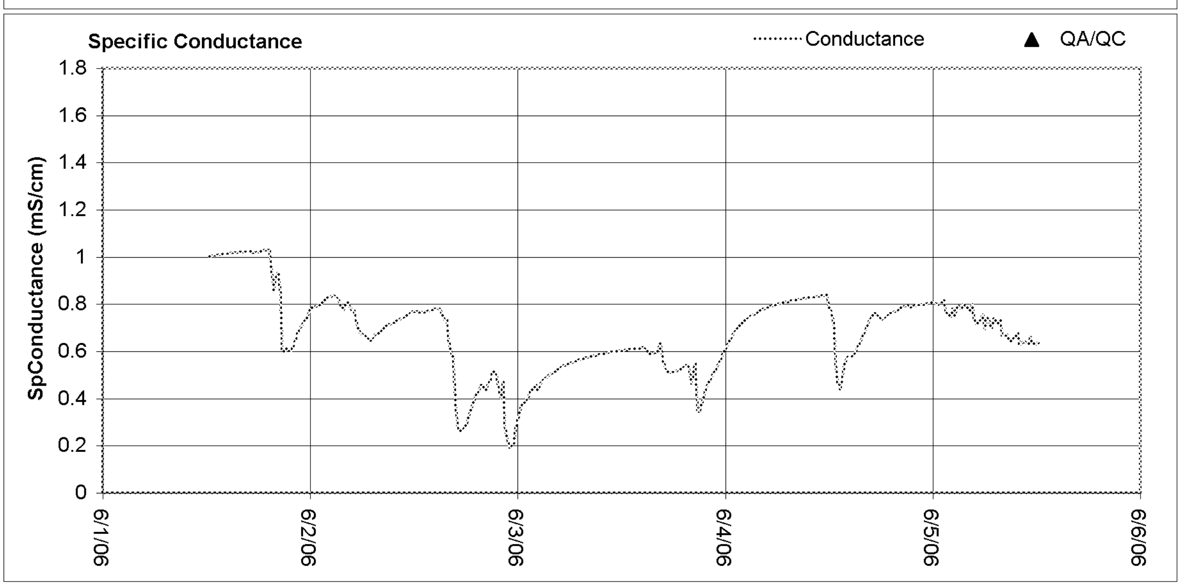
Becks Run 1



Calibrated Radar Rainfall Data
rainfall (inches)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/1/06
6/2/06
6/3/06
6/4/06
6/5/06
6/6/06

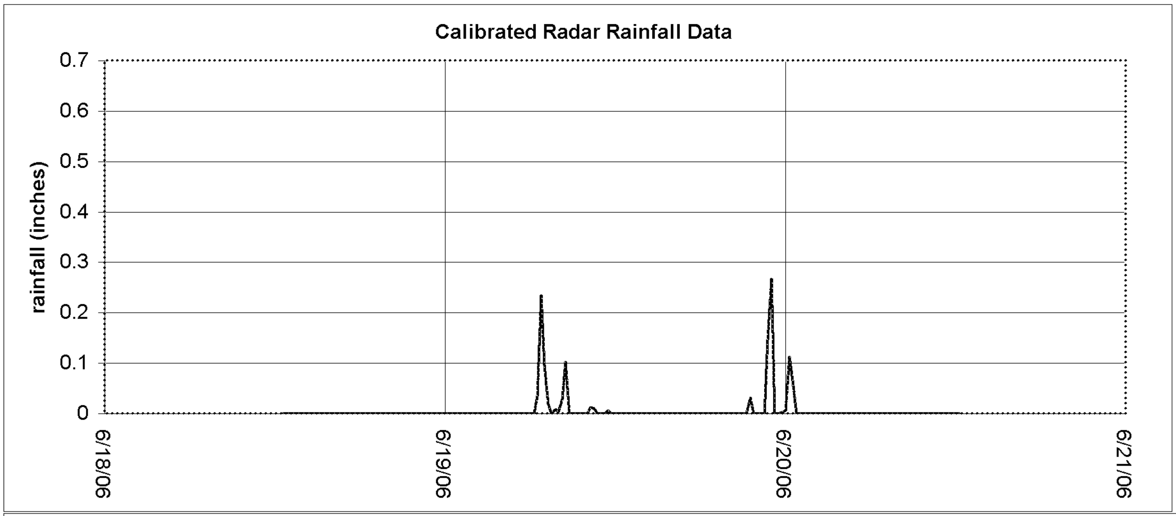


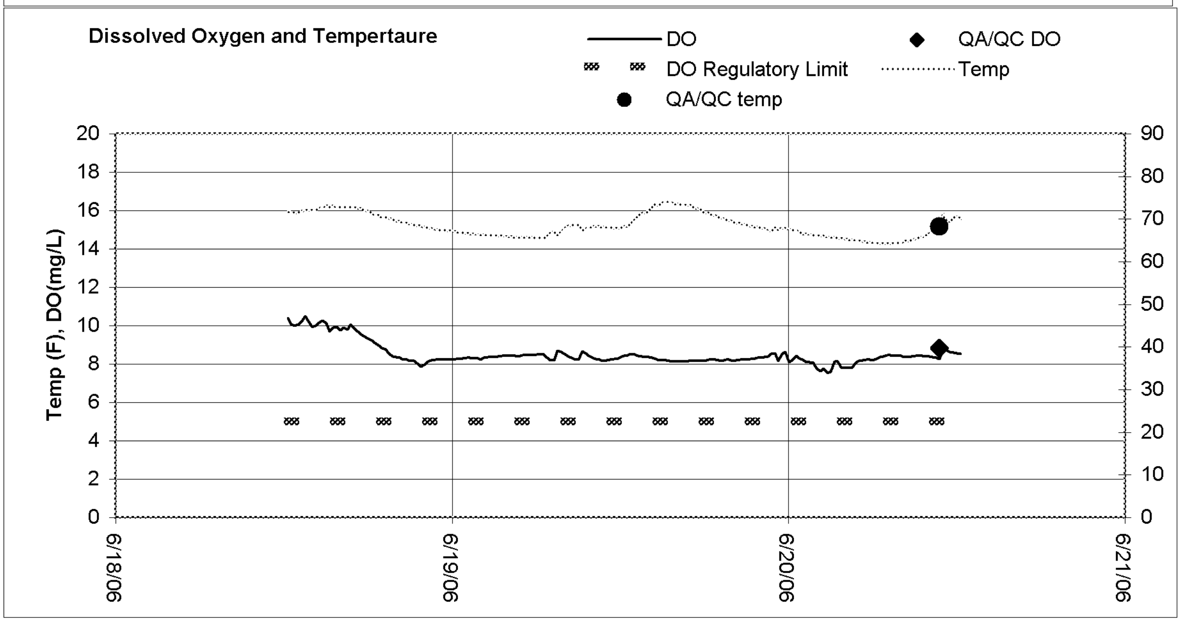
Dissolved Oxygen and Tempertaure
DO
QA/QC DO
DO Regulatory Limit
Temp
QA/QC temp
Temp (F), DO(mg/L)
20
18
16
14
12
10
8
6
4
2
0
90
80
70
60
50
40
30
20
10
0
6/1/06
6/2/06
6/3/06
6/4/06
6/5/06
6/6/06

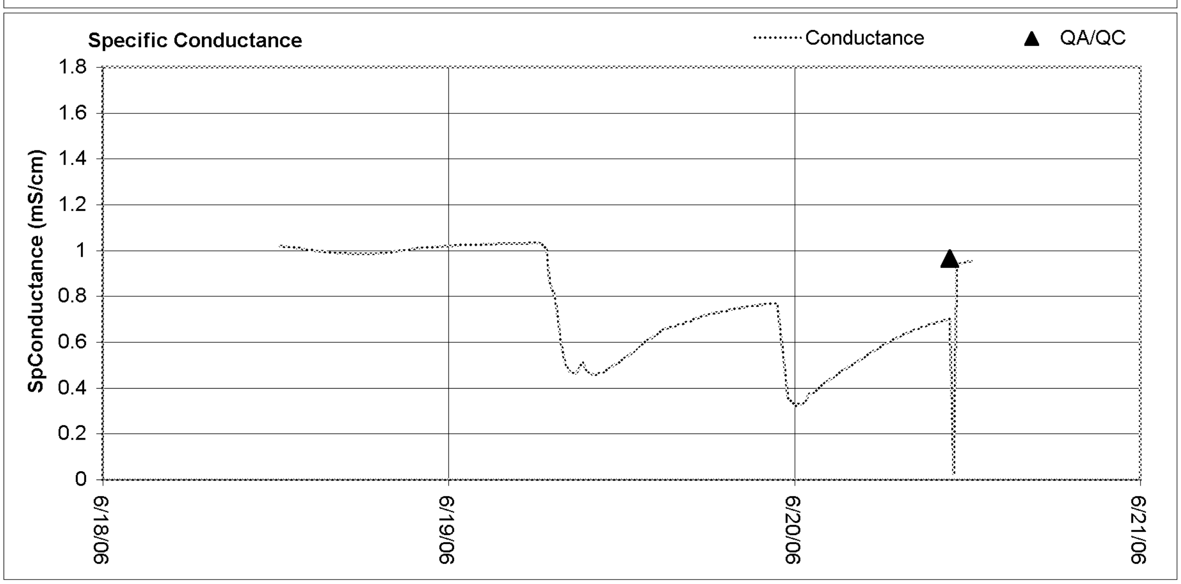


Specific Conductance
Conductance
QA/QC
SpConductance (mS/cm)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
6/1/06
6/2/06
6/3/06
6/4/06
6/5/06
6/6/06

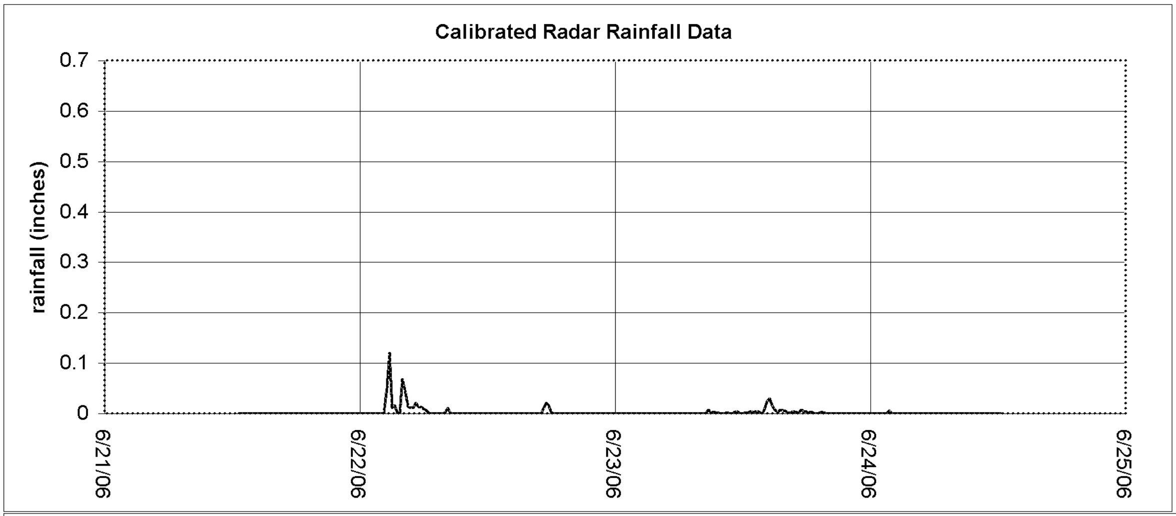
Becks Run 1
(Probable CSO)

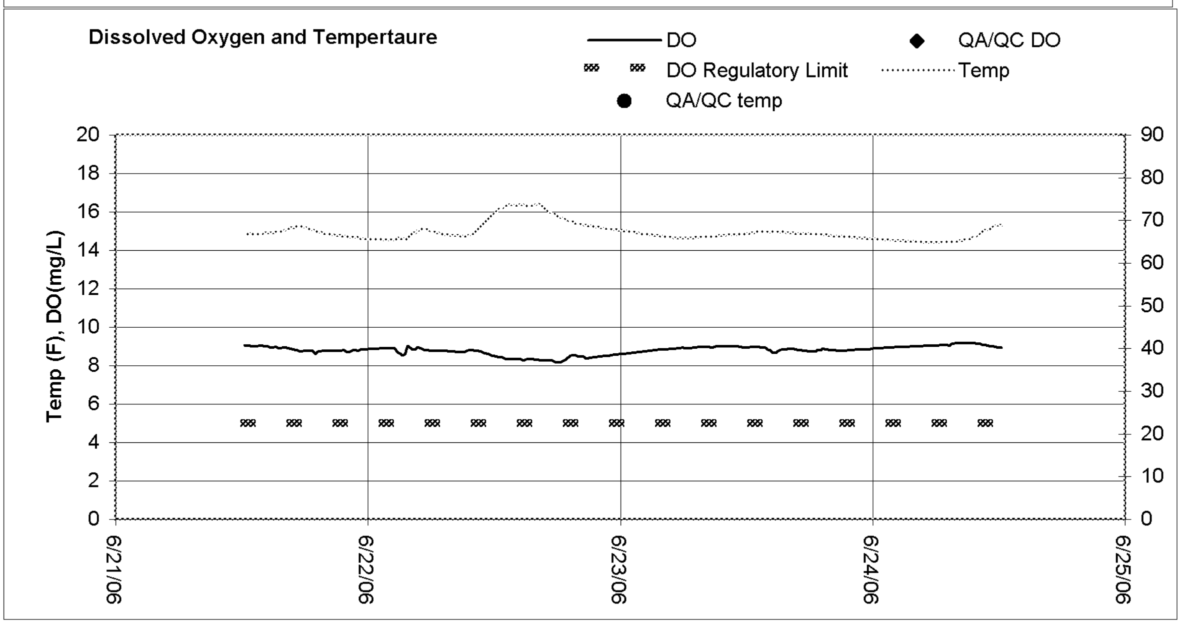


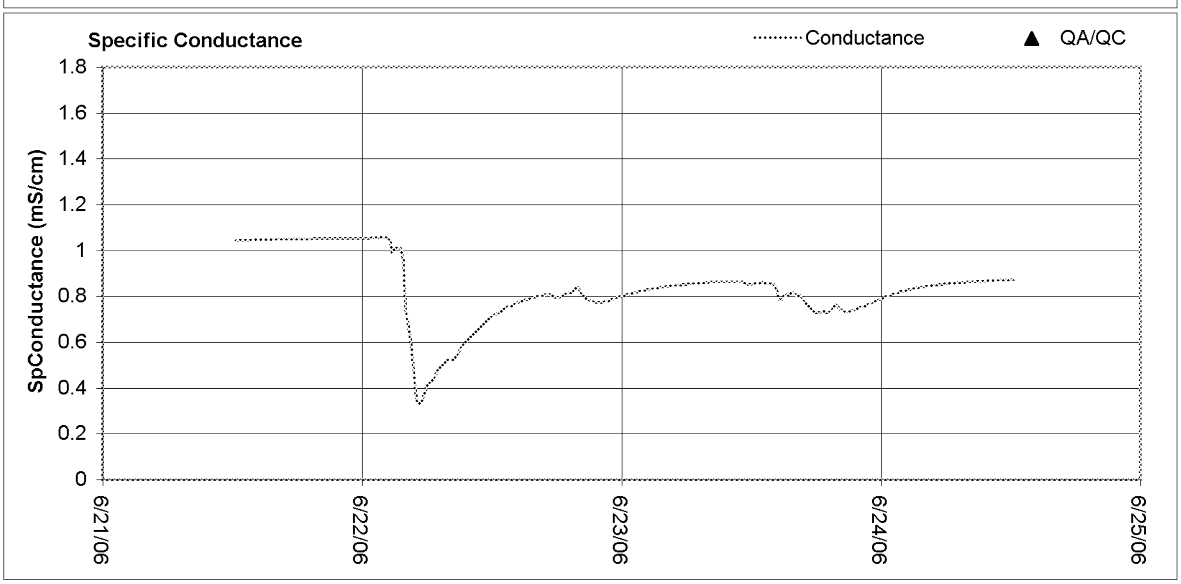




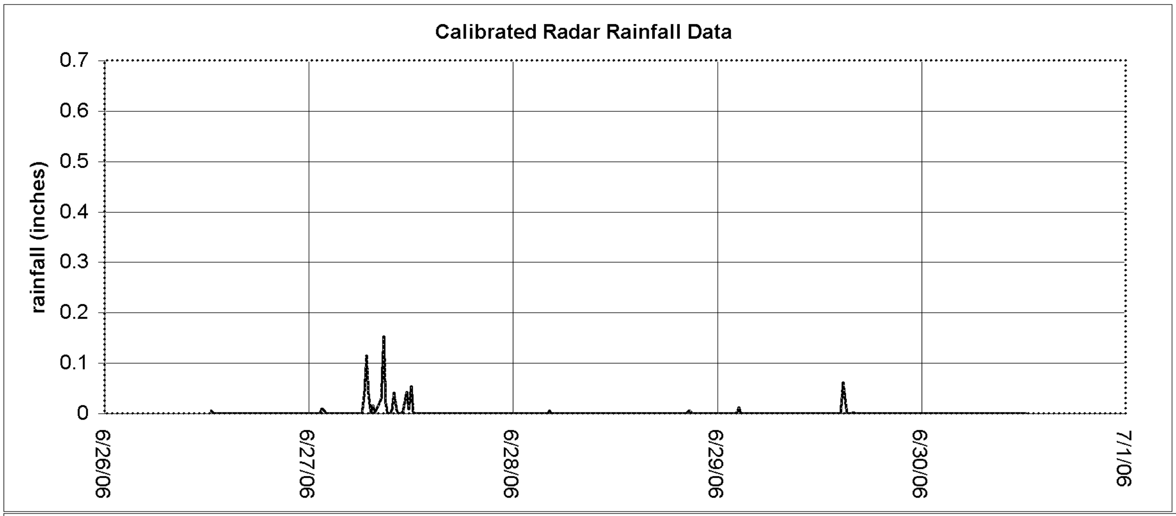
Becks Run 1
(Probable CSO)

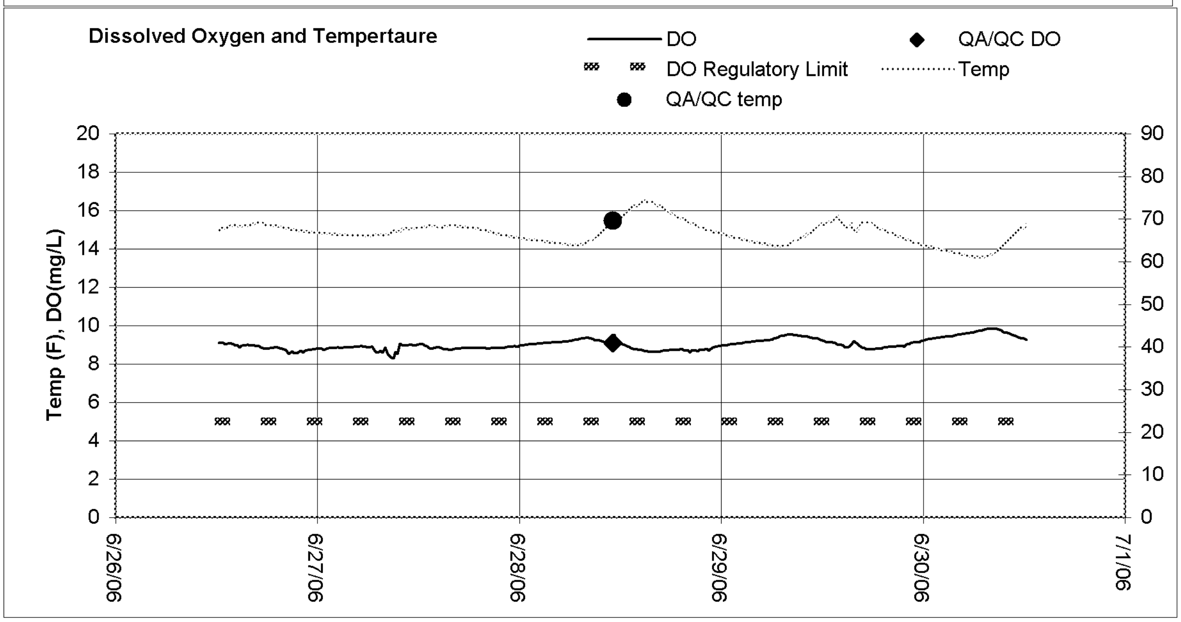


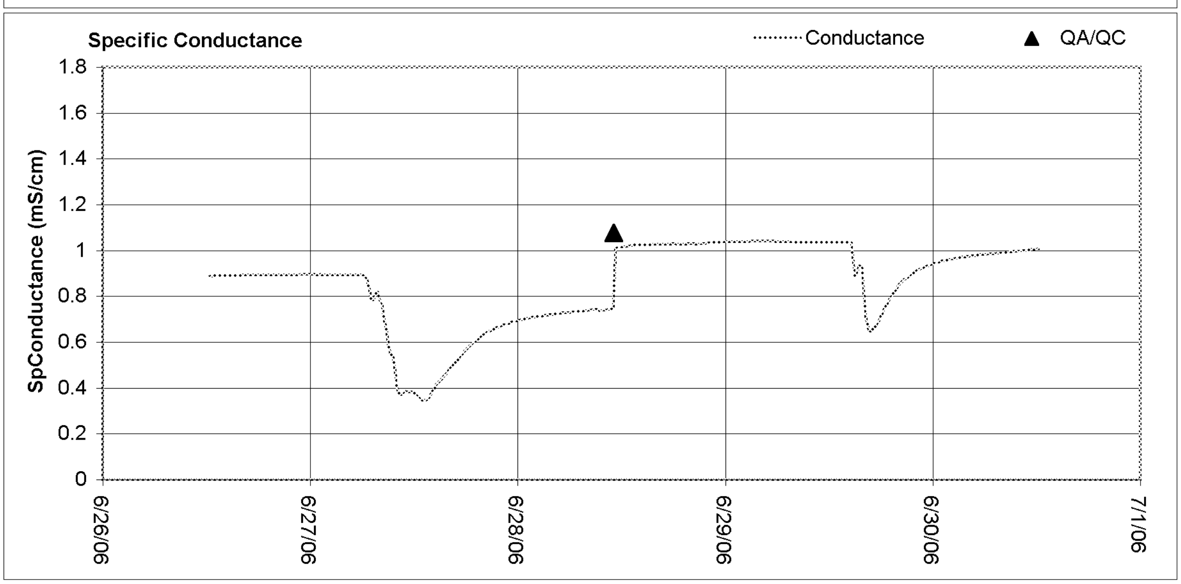




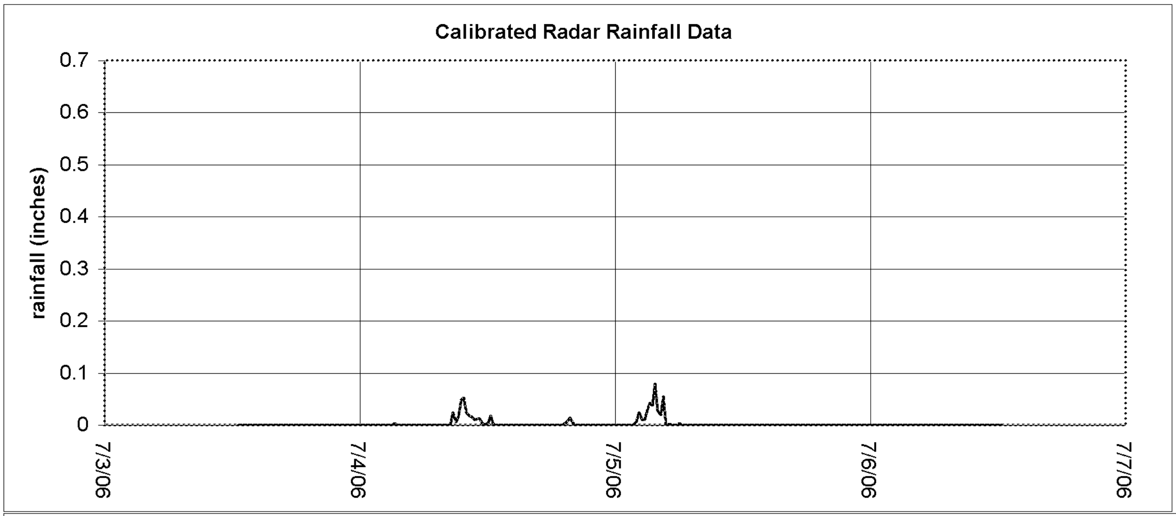
Becks Run 1
(Probable CSO)

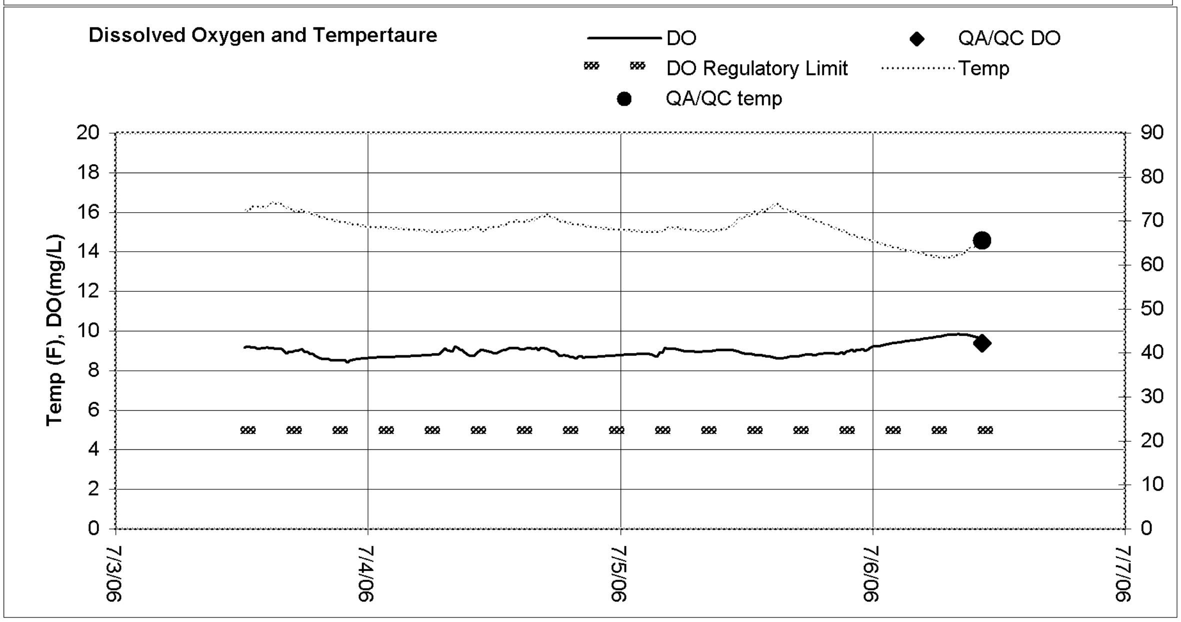


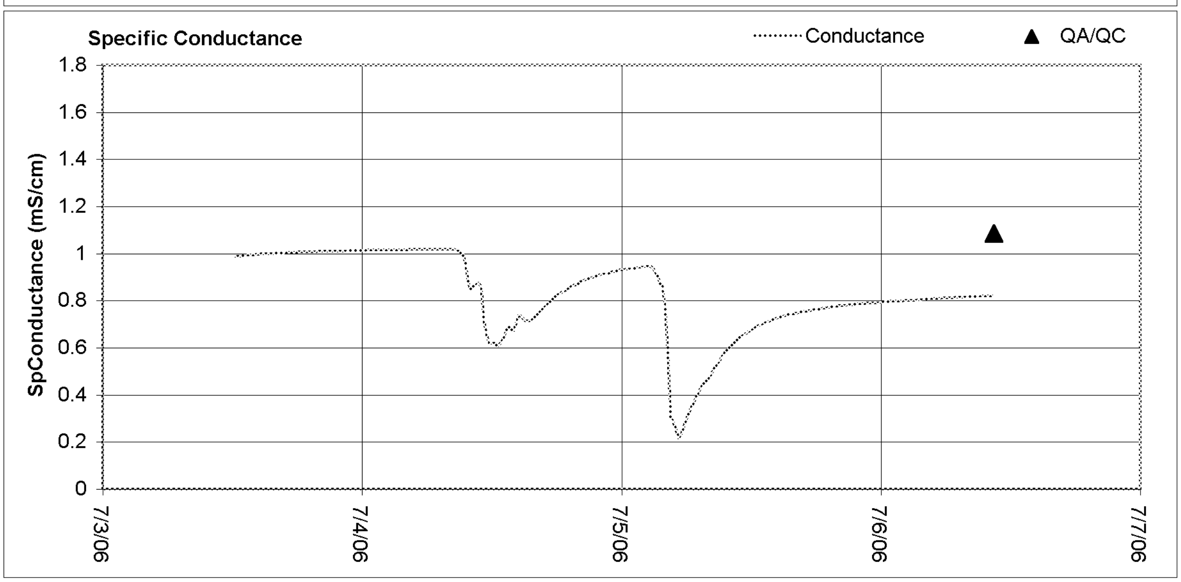




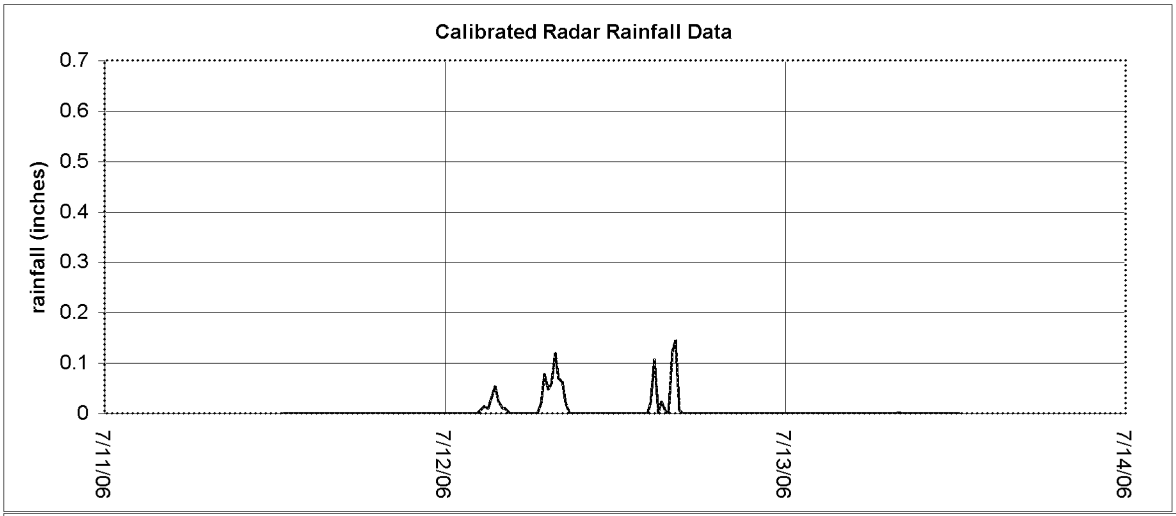
Becks Run 1
(Probable CSO)

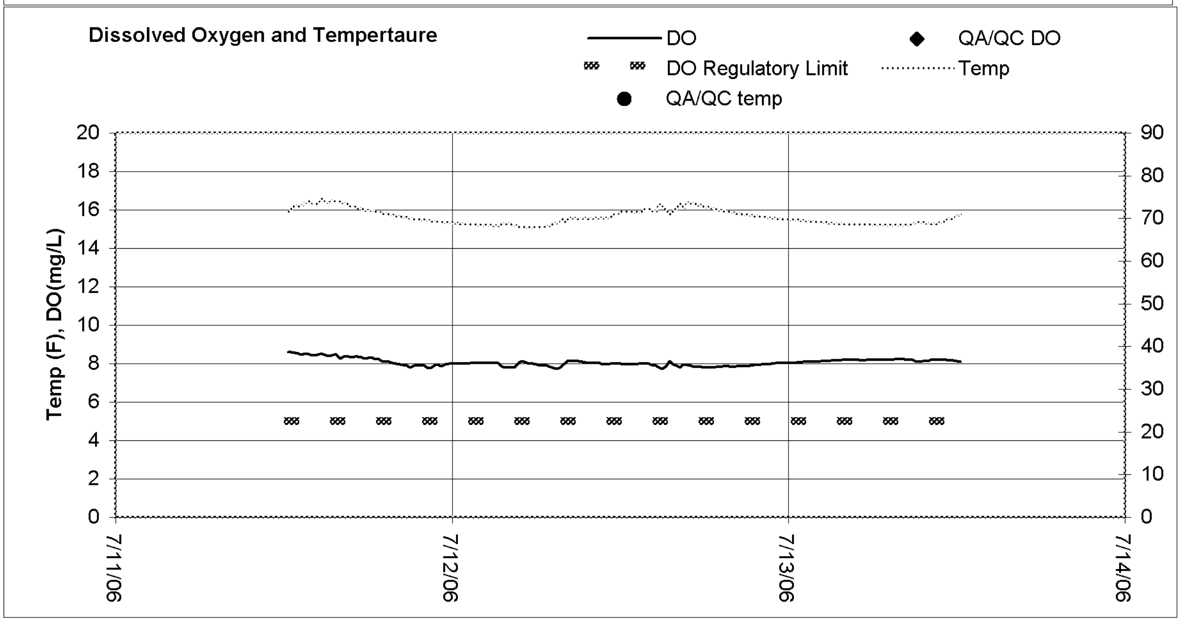


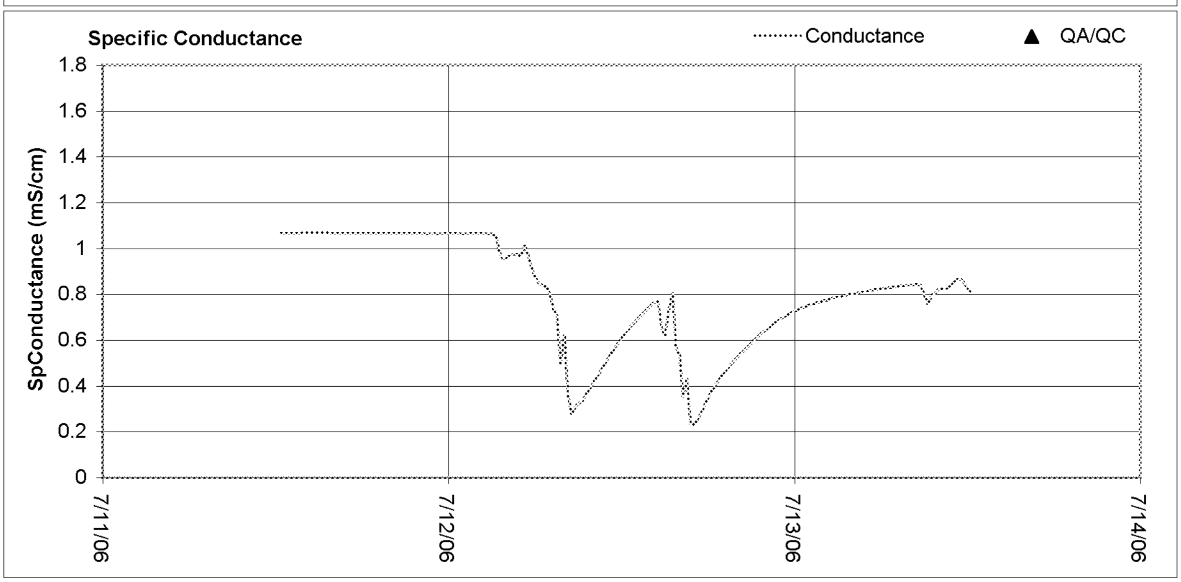




Becks Run 1
(Probable CSO)

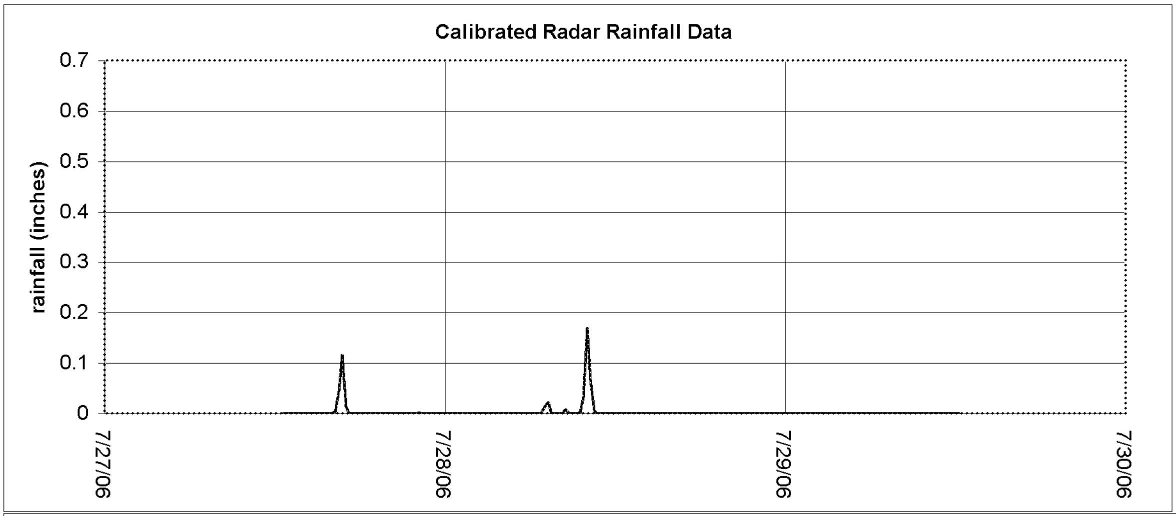


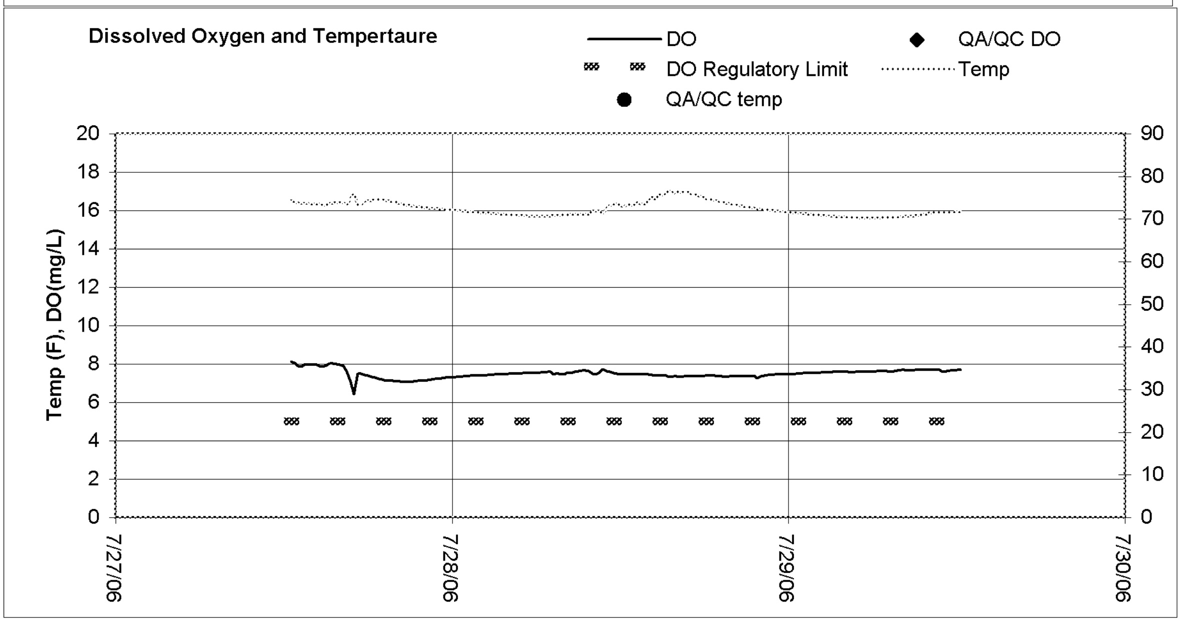


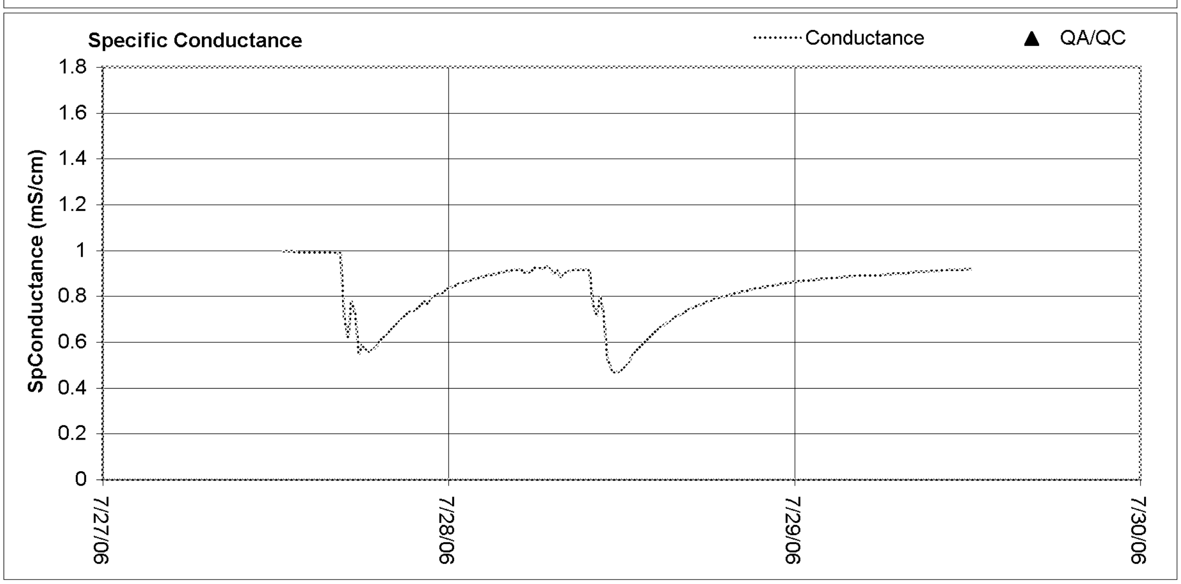


ATTACHMENT C - APPENDIX B

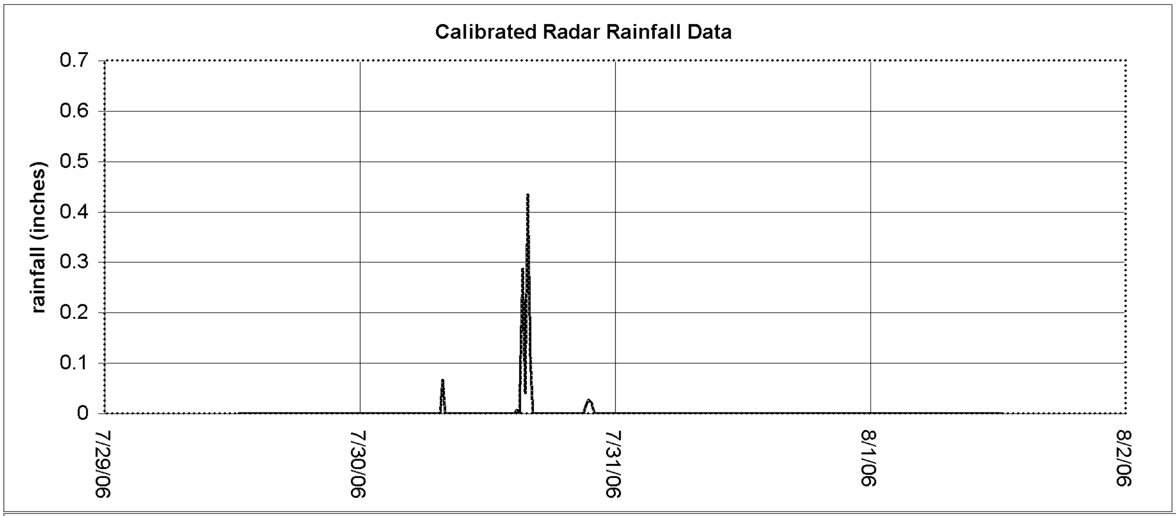
Becks Run 1
(Probable CSO)

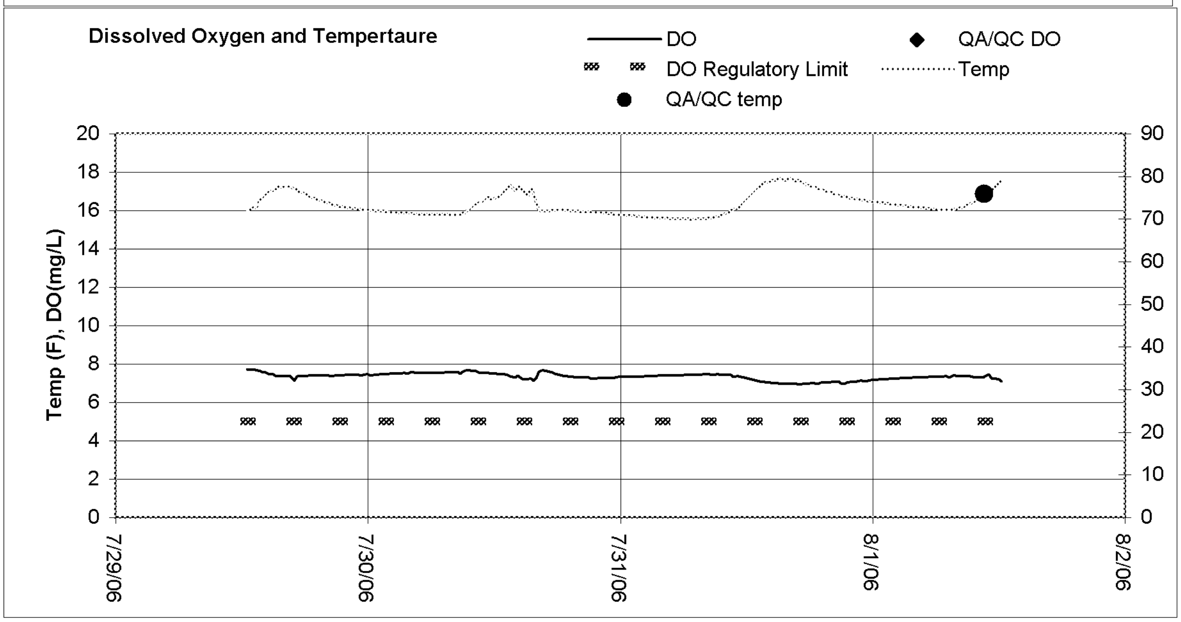


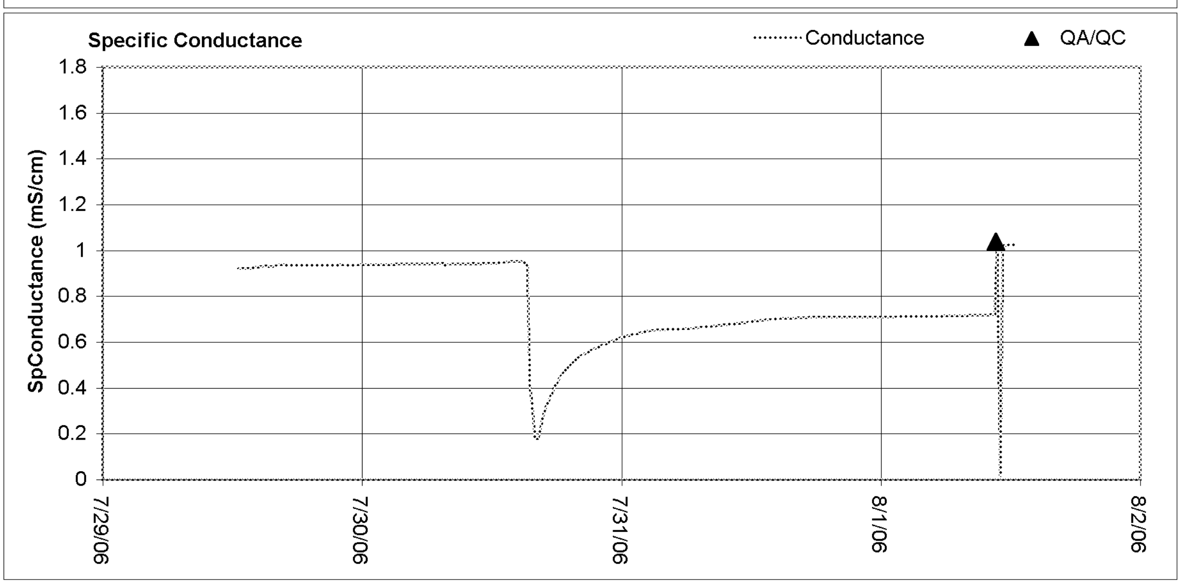




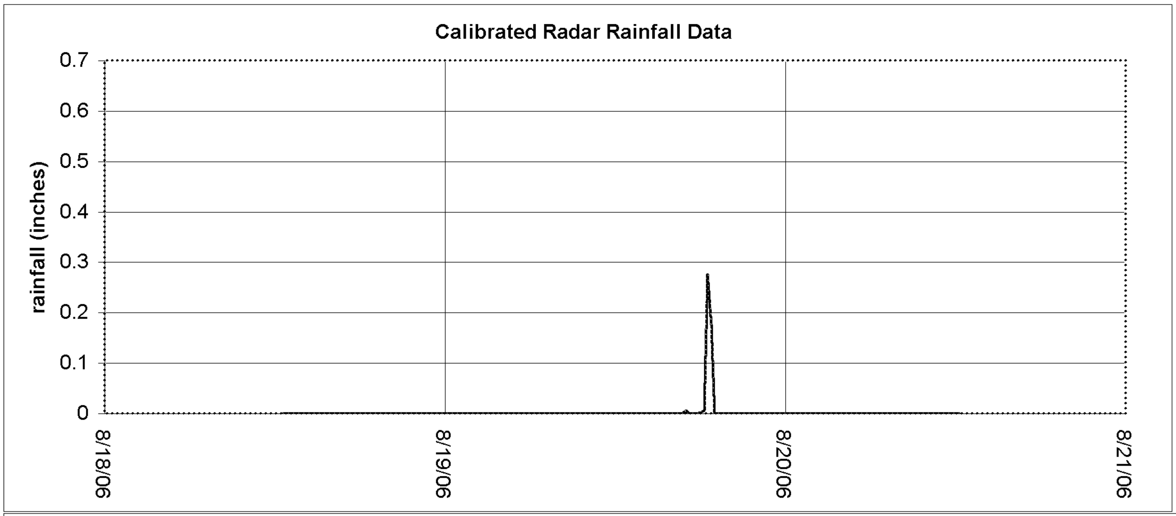
Becks Run 1
(Probable CSO)

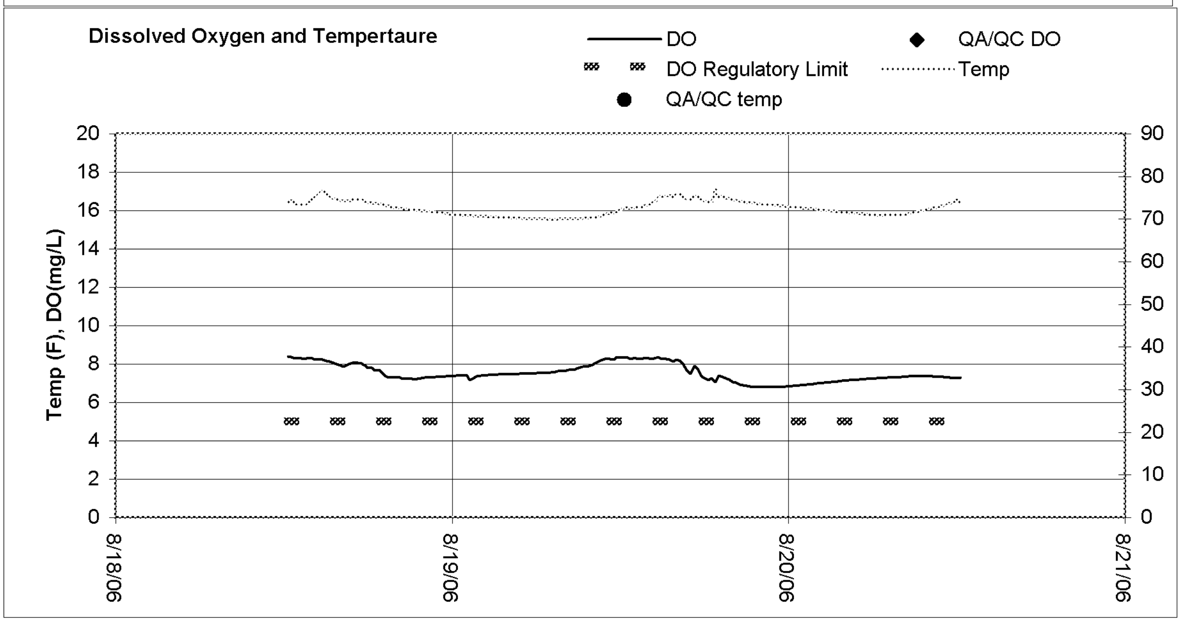


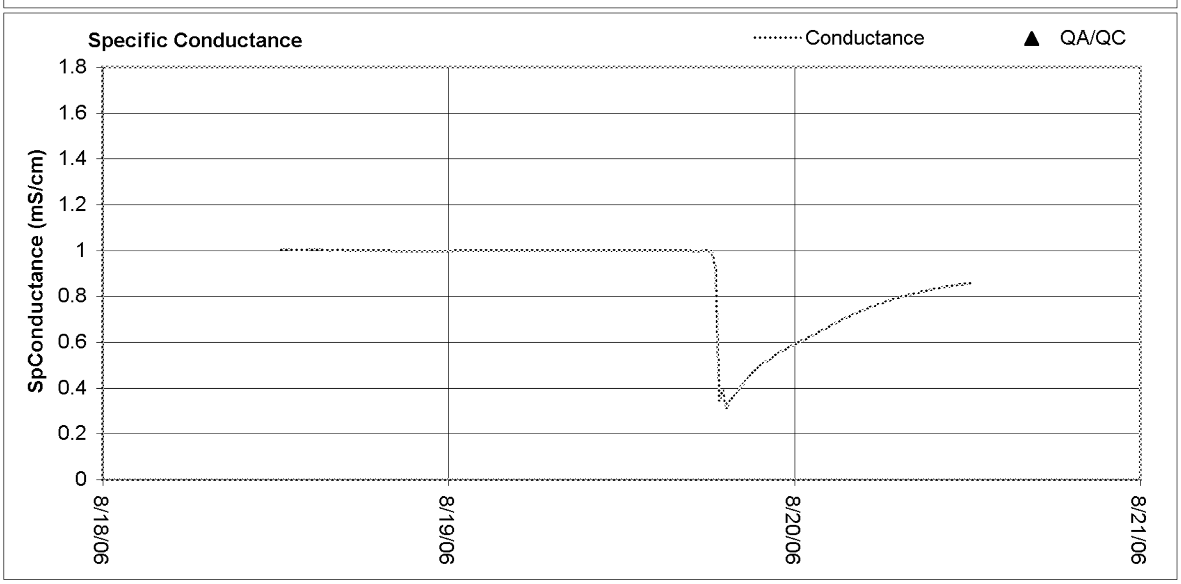




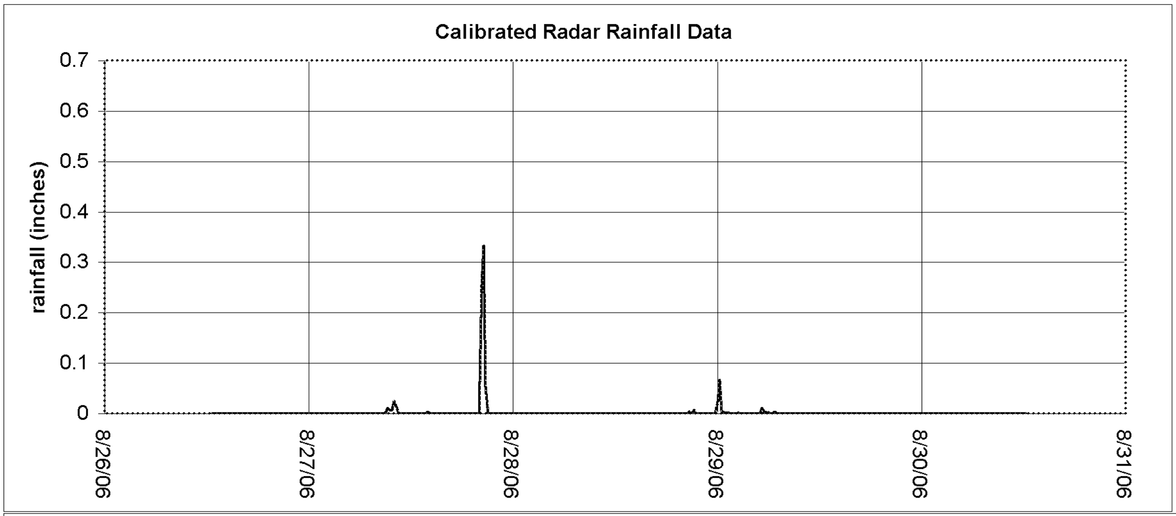
Becks Run 1

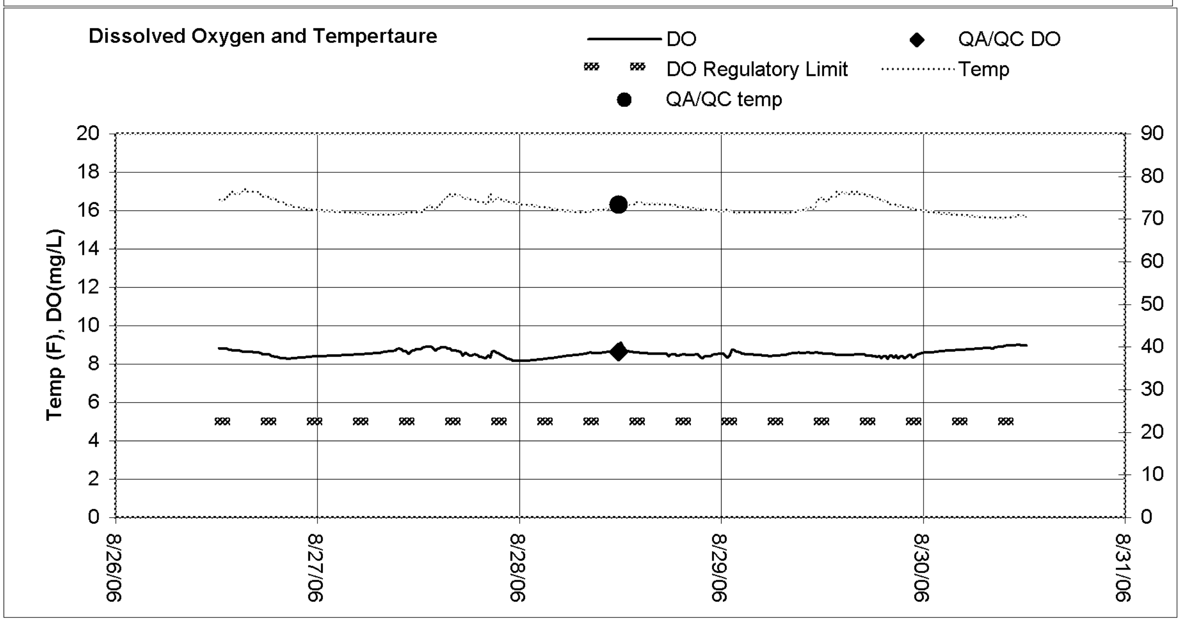

Calibrated Radar Rainfall Data
rainfall (inches)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8/18/06
8/19/06
8/20/06
8/21/06

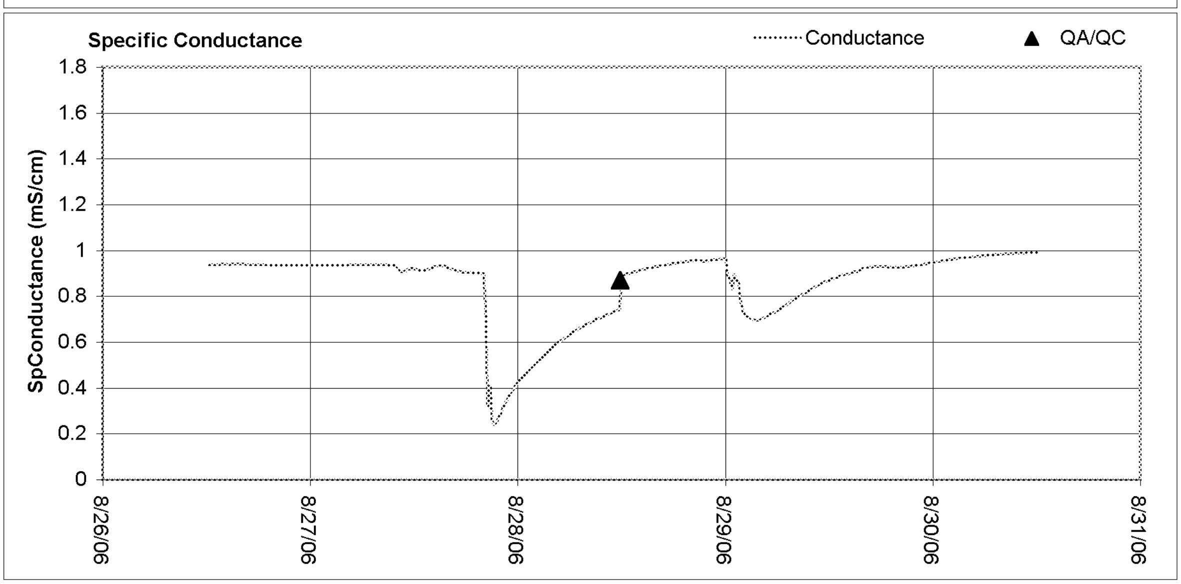

Dissolved Oxygen and Tempertaure
DO
QA/QC DO
DO Regulatory Limit
Temp
QA/QC temp
Temp (F), DO(mg/L)
20
18
16
14
12
10
8
6
4
2
0
90
80
70
60
50
40
30
20
10
0
8/18/06
8/19/06
8/20/06
8/21/06


Specific Conductance
Conductance
QA/QC
SpConductance (mS/cm)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
8/18/06
8/19/06
8/20/06
8/21/06

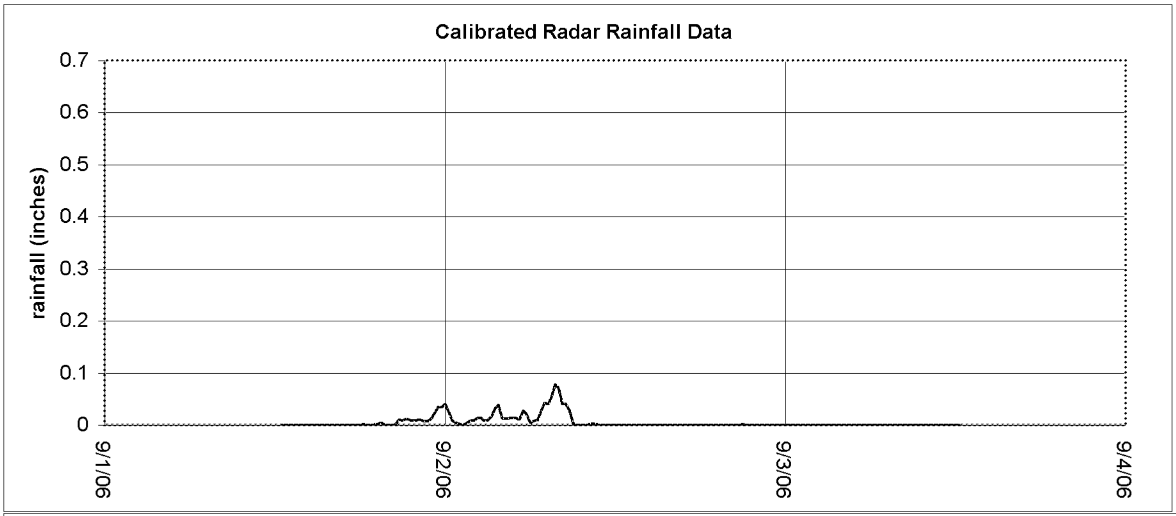
Becks Run 1
(Probable CSO)

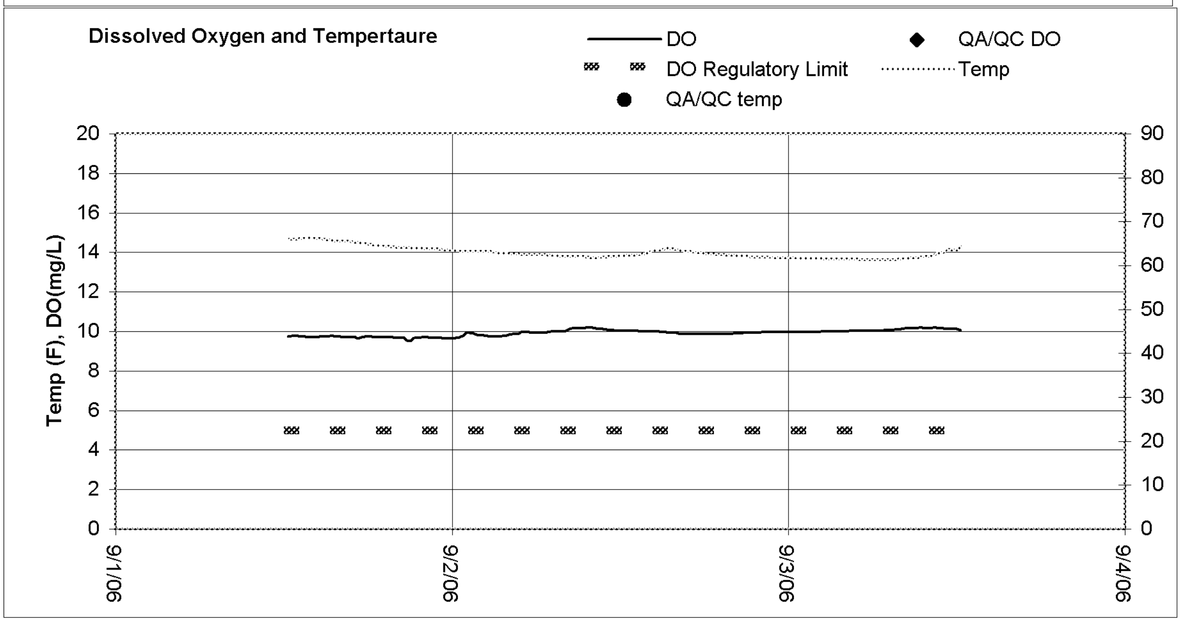


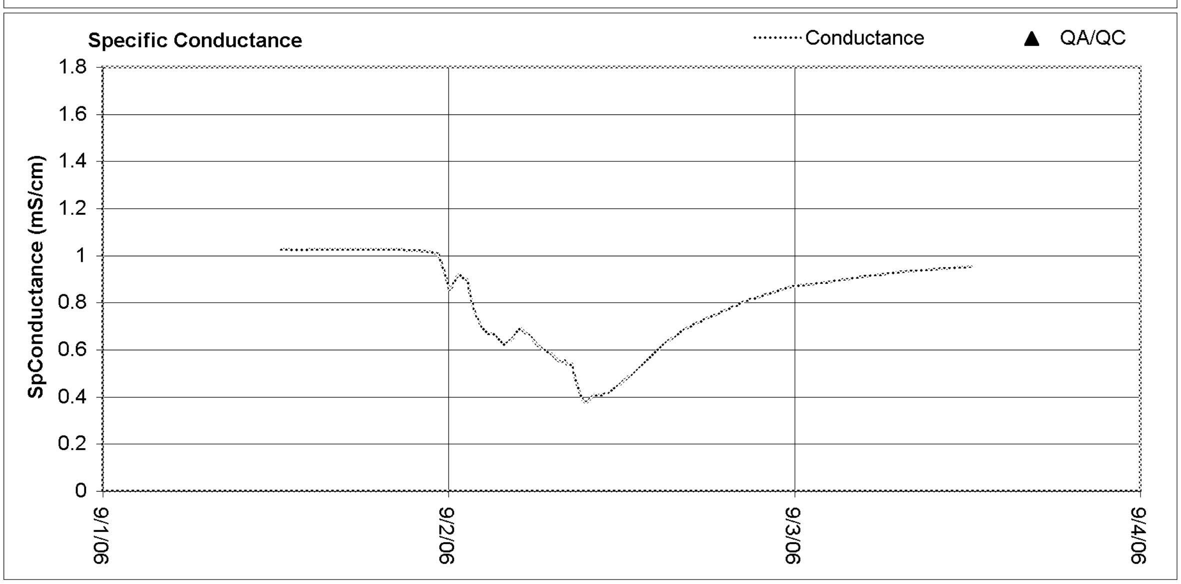




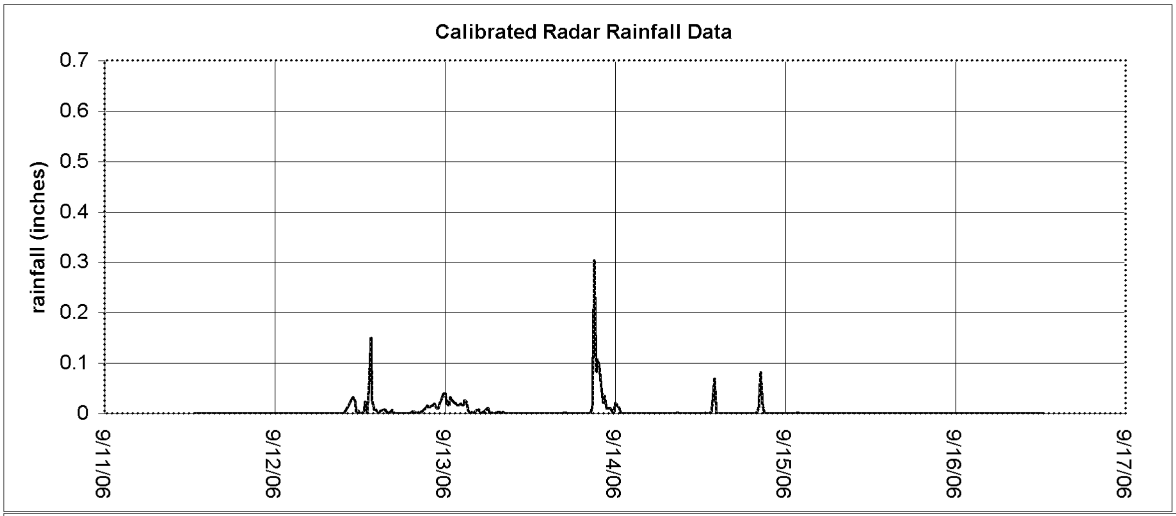
Becks Run 1
(Probable CSO)

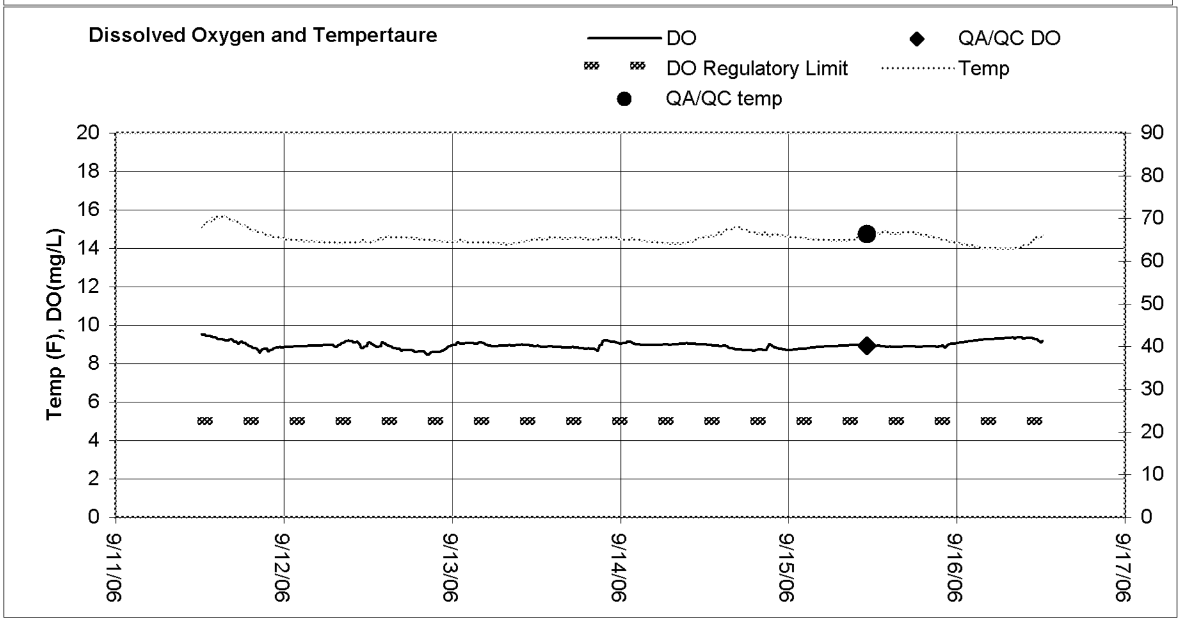


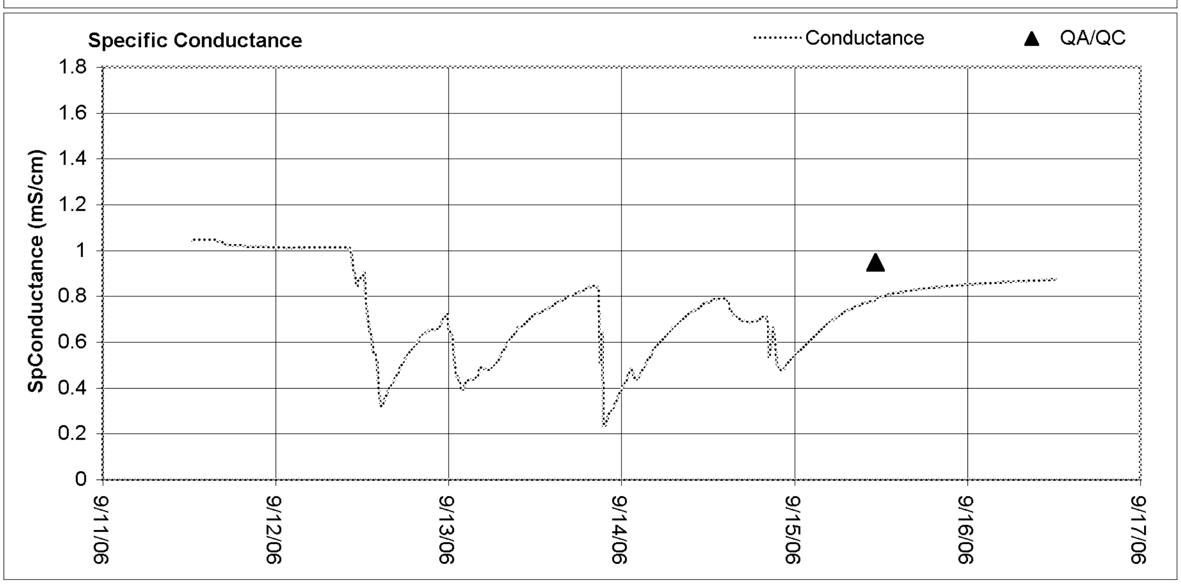




Becks Run 1
(Probable CSO)

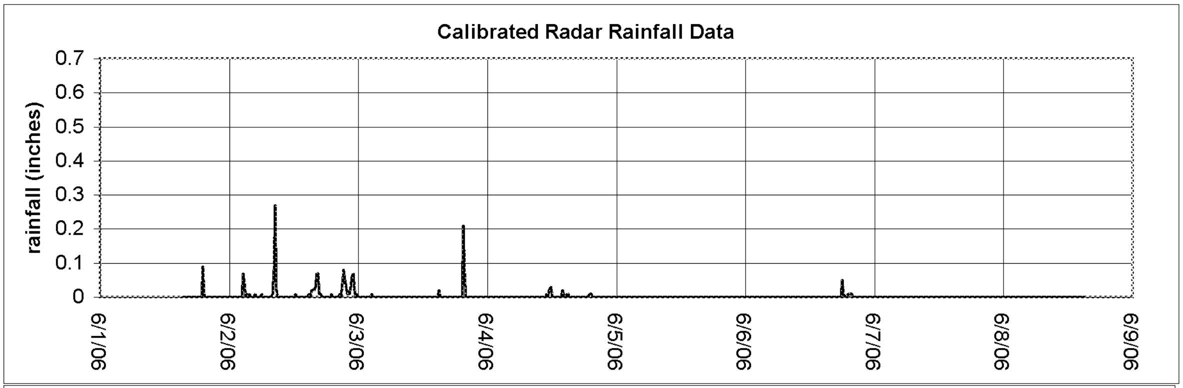


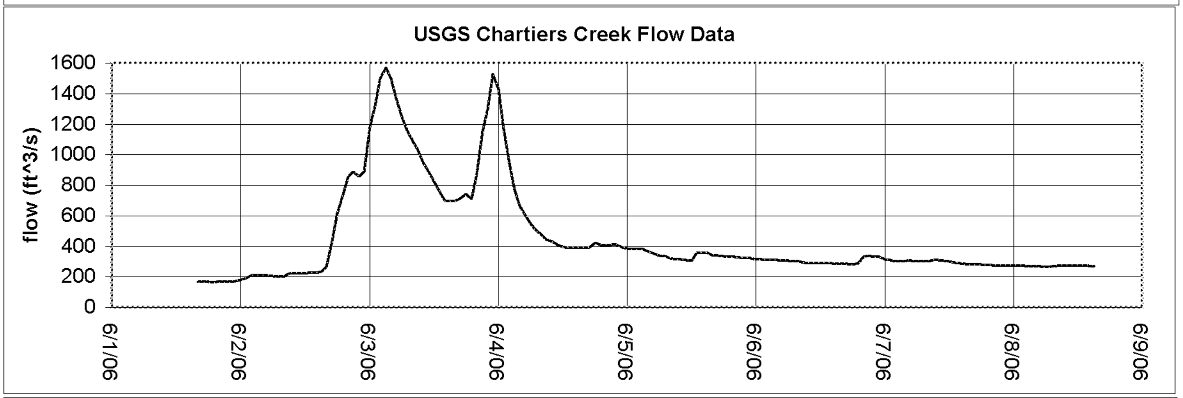


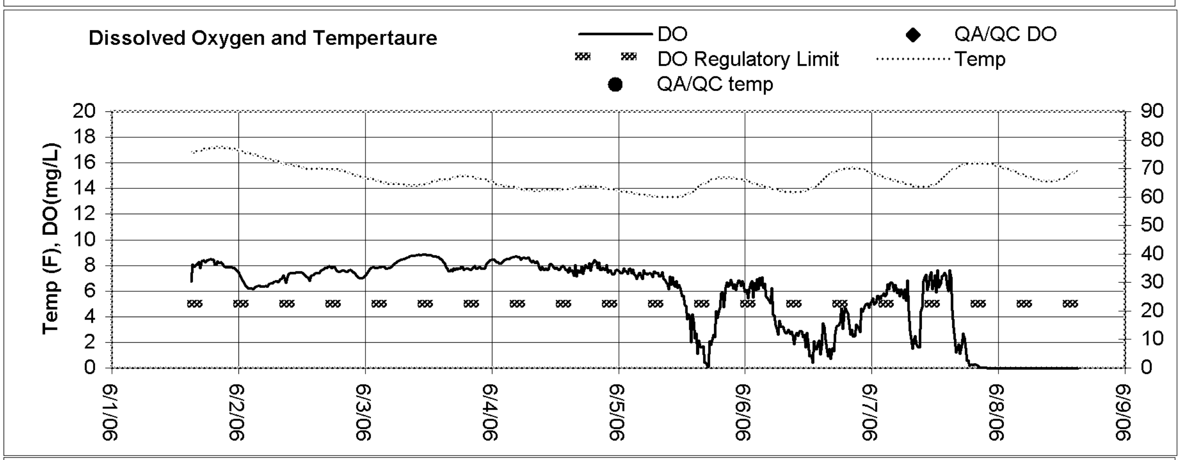


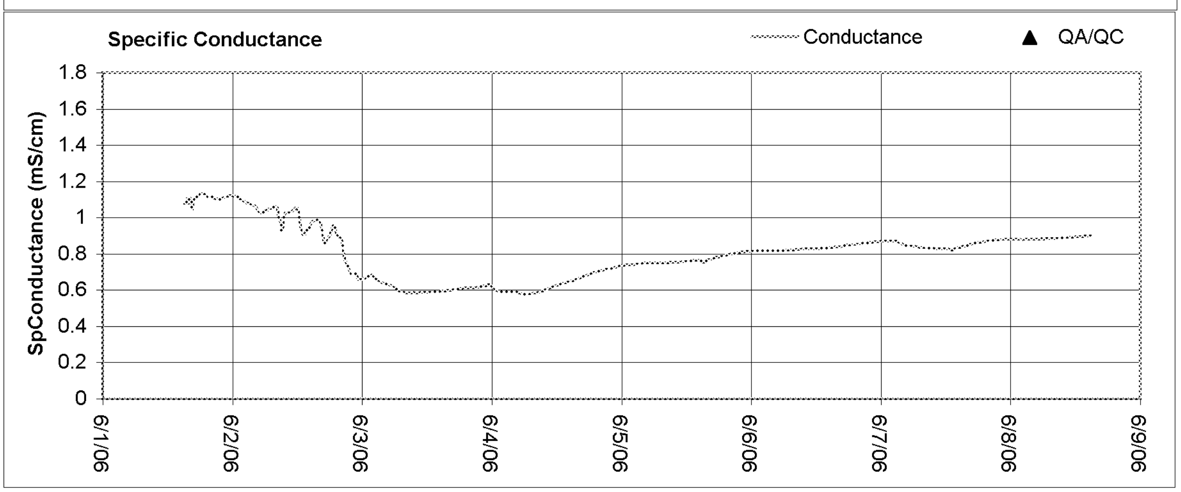
CHARTIERS CREEK (CC-SW-1)
WET WETHER DATA GRAPHS

Chartiers Creek 1
(Probable CSO)

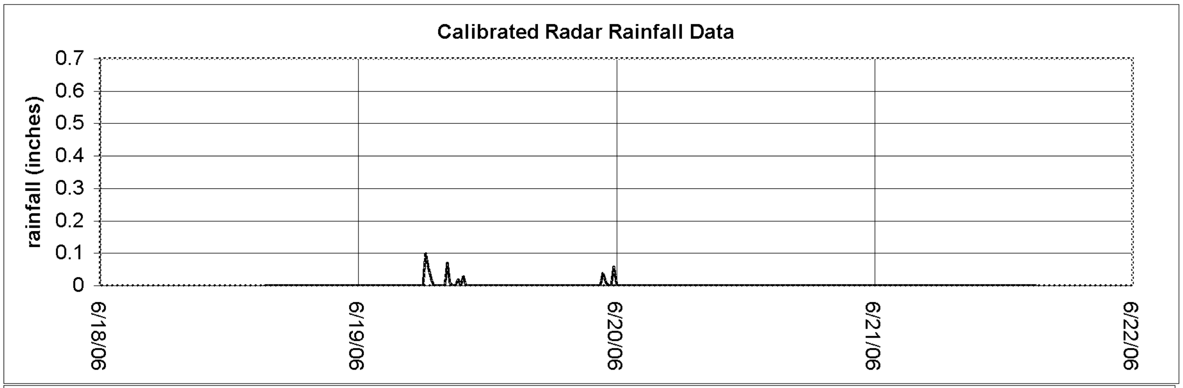


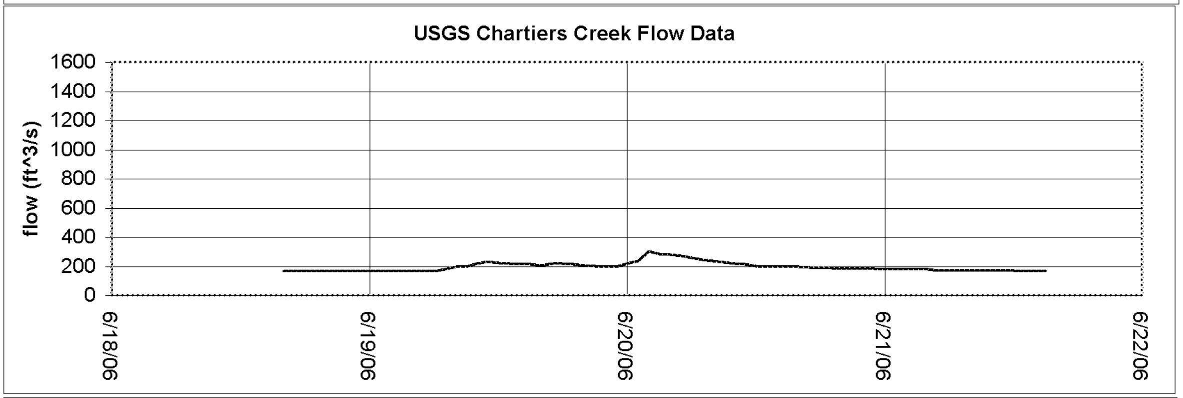


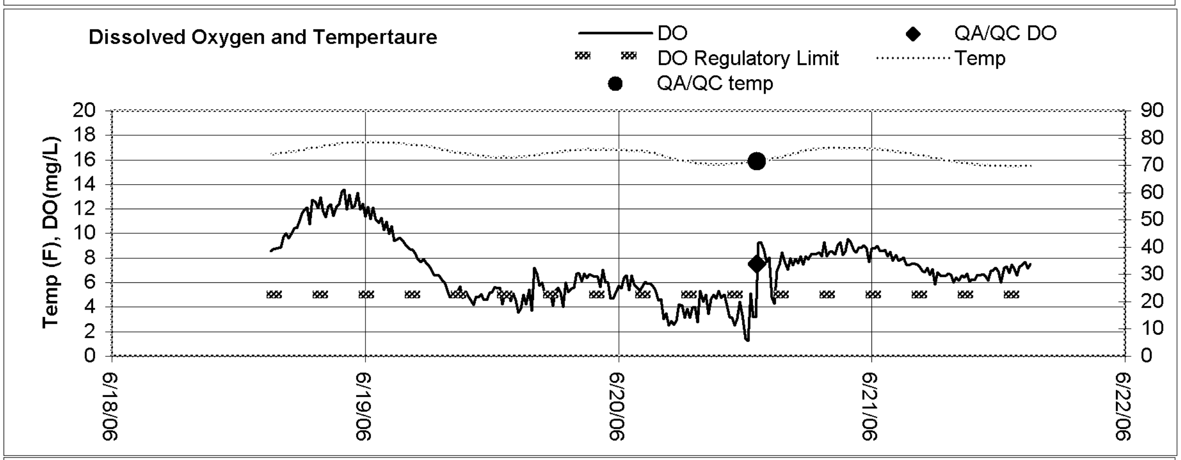


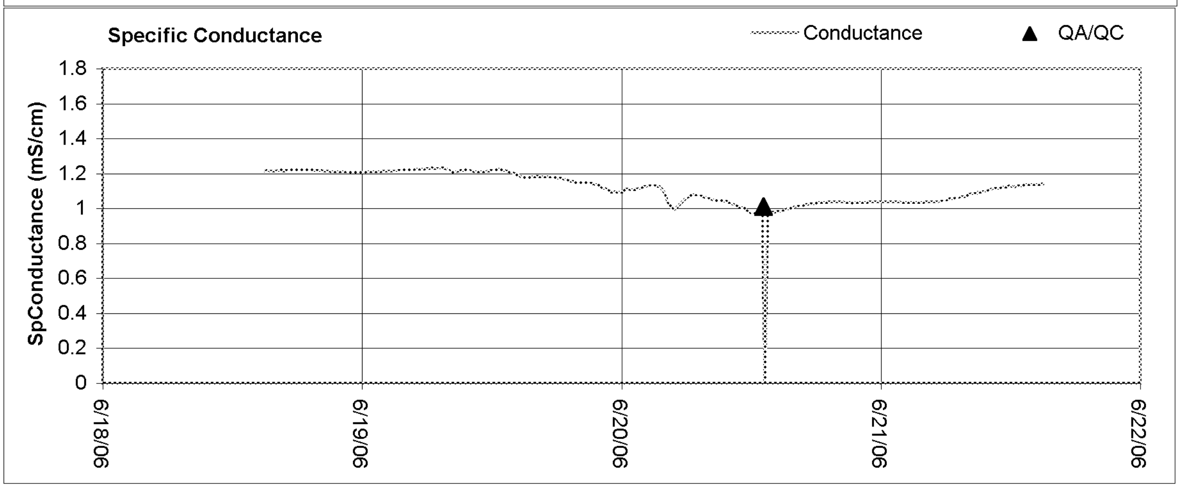


Chartiers Creek 1

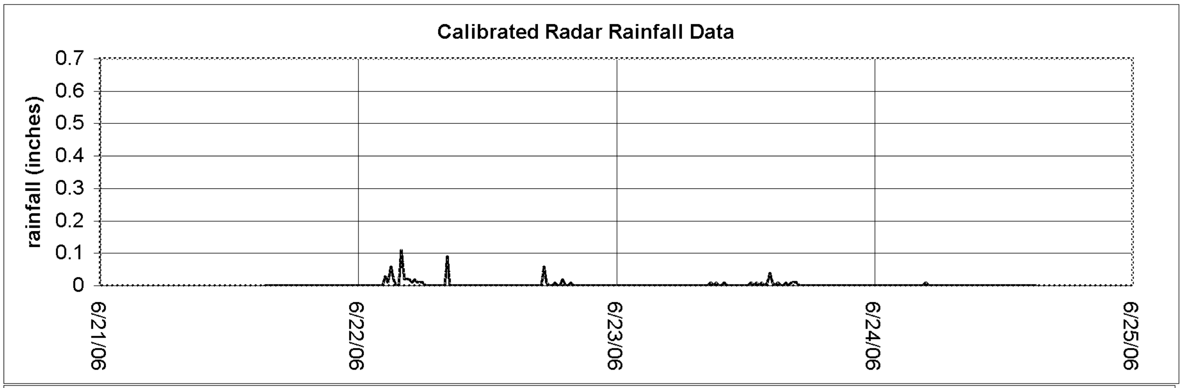


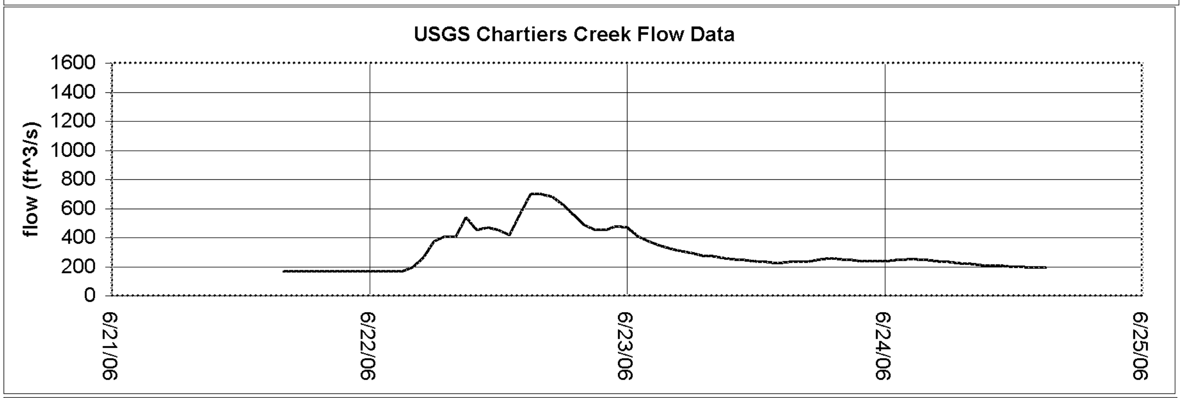


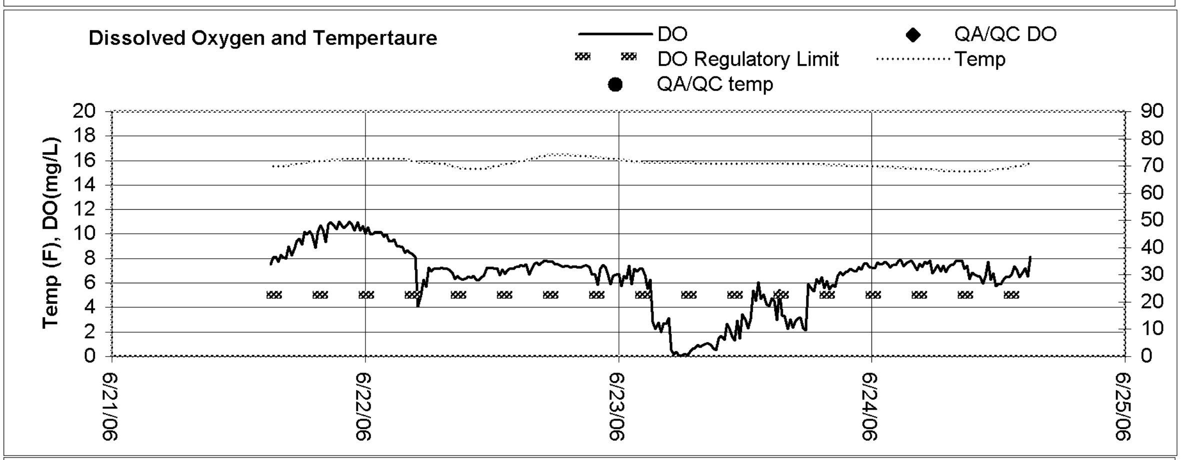


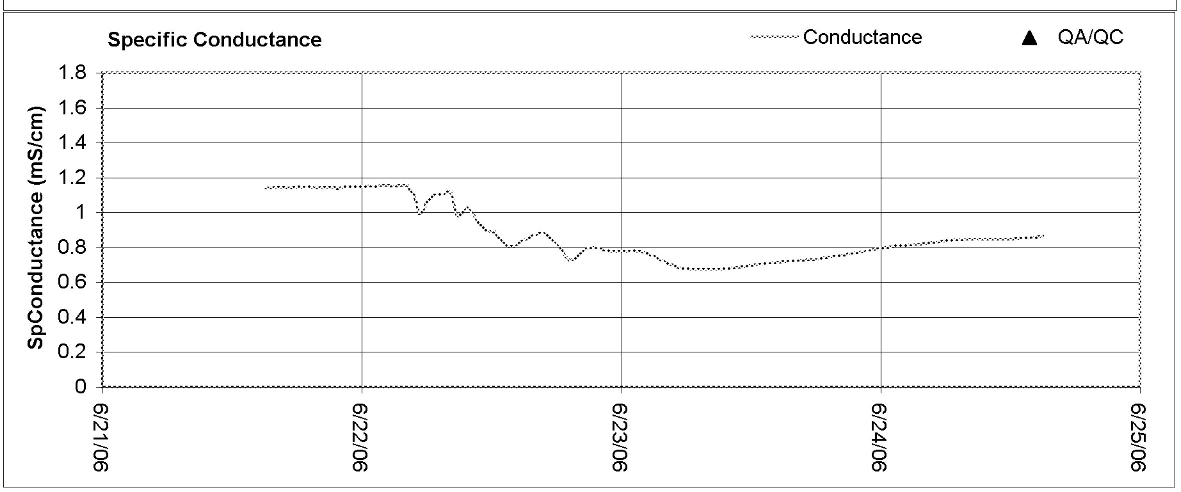


Chartiers Creek 1









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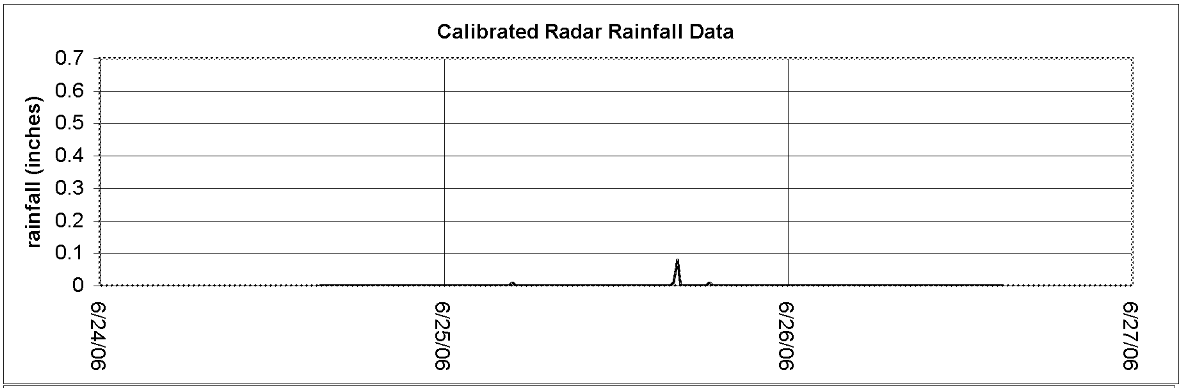

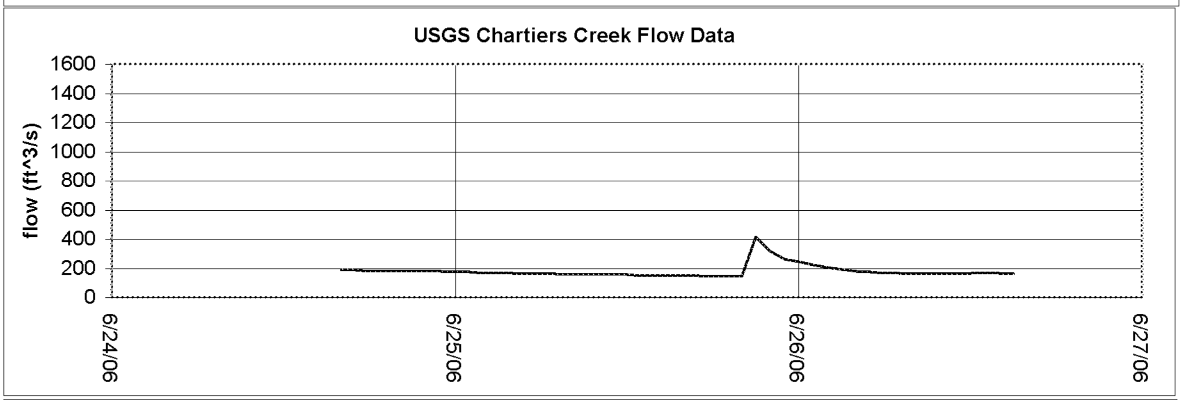

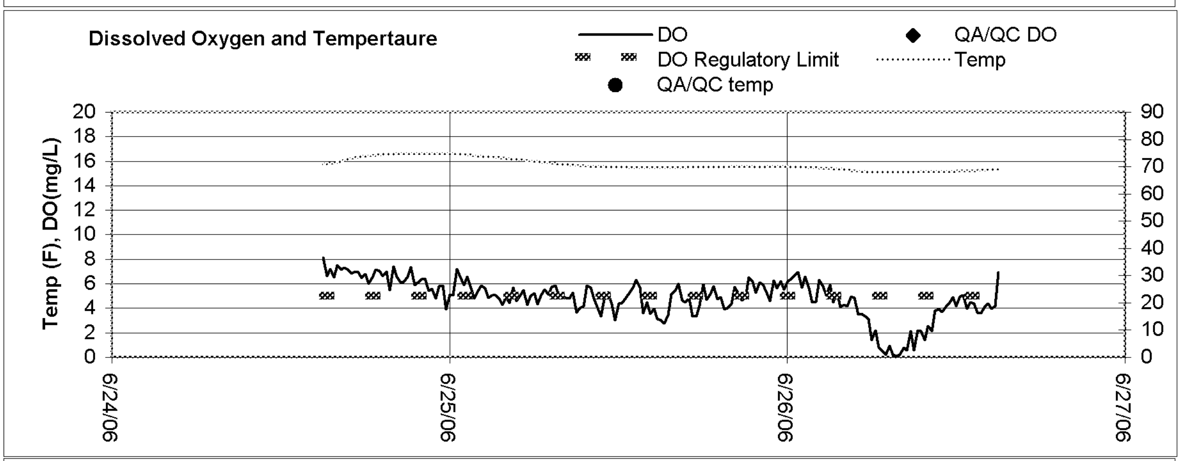

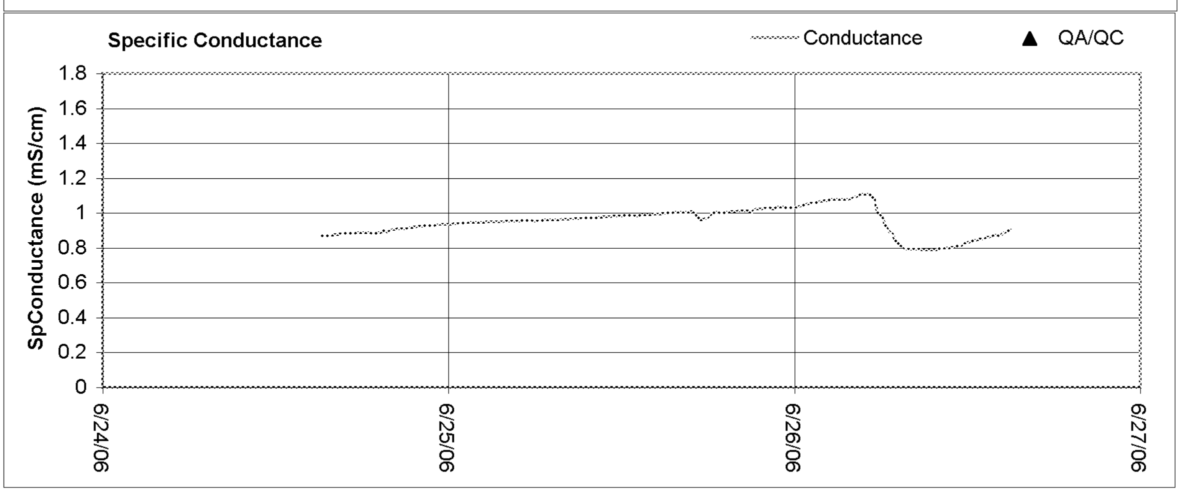

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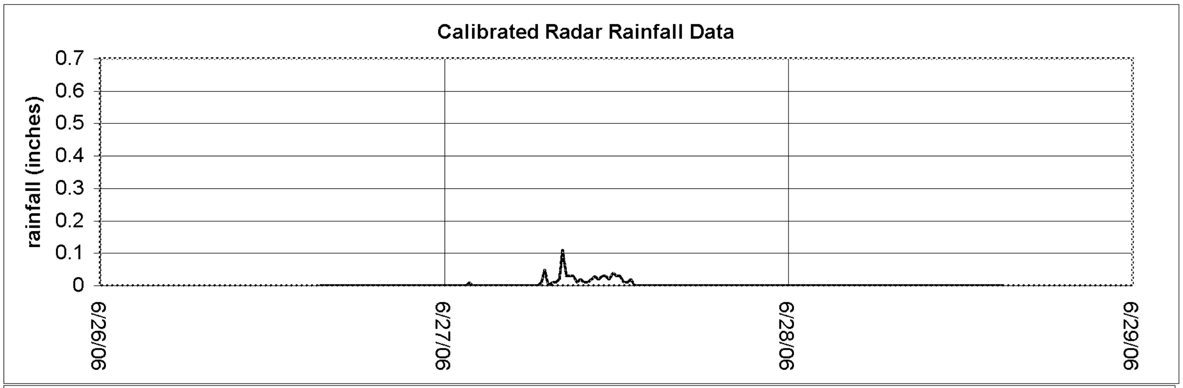
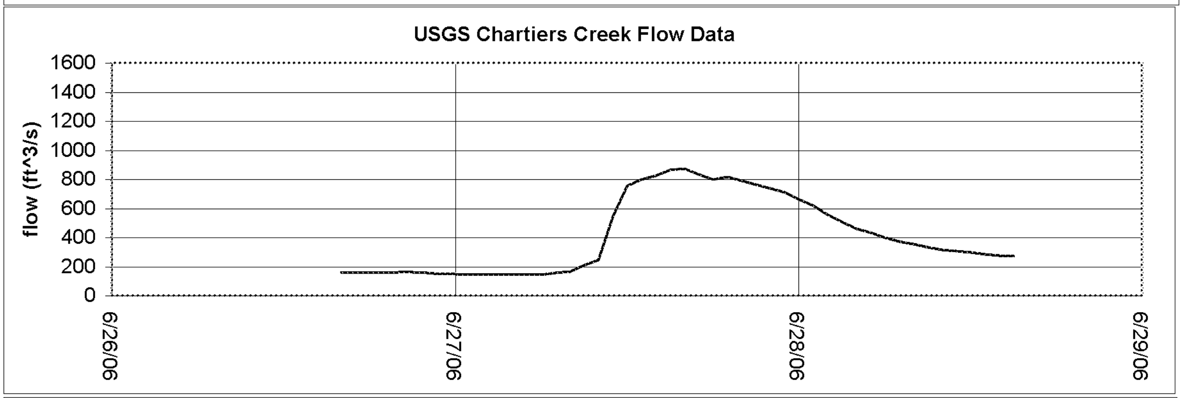
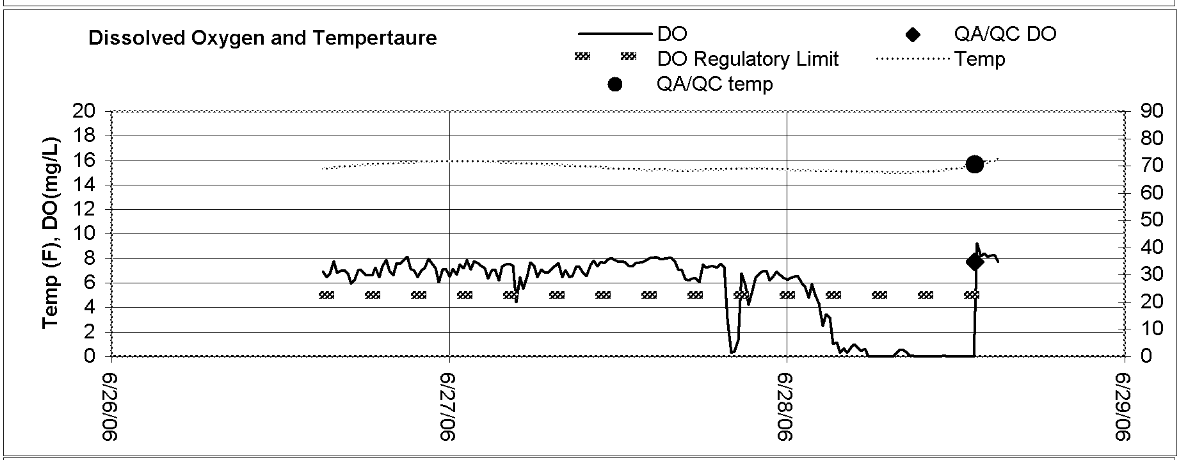
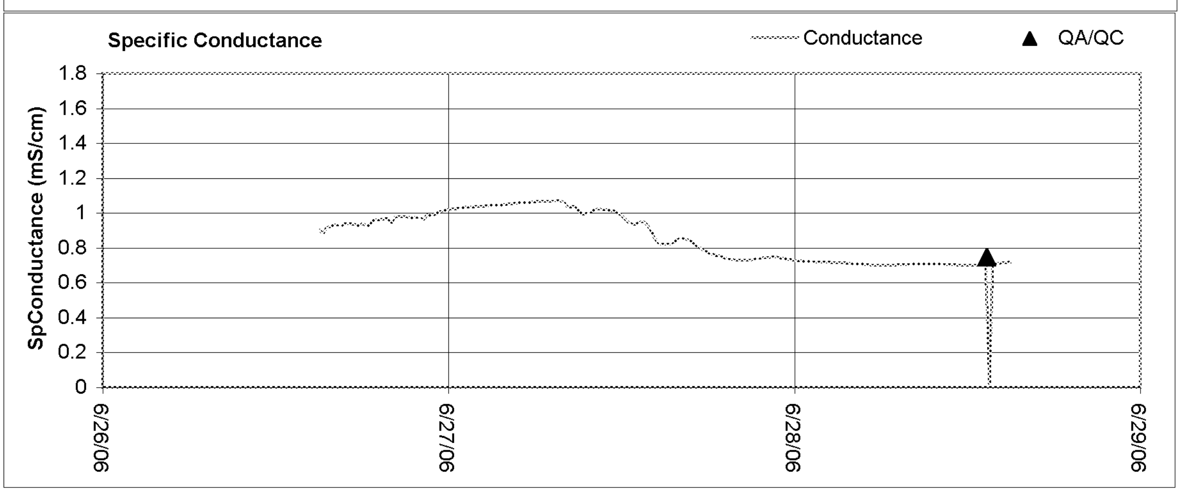
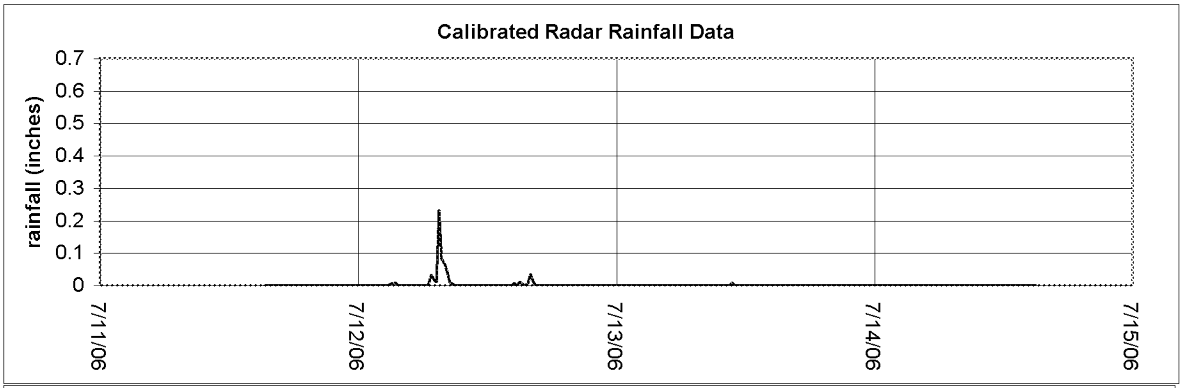


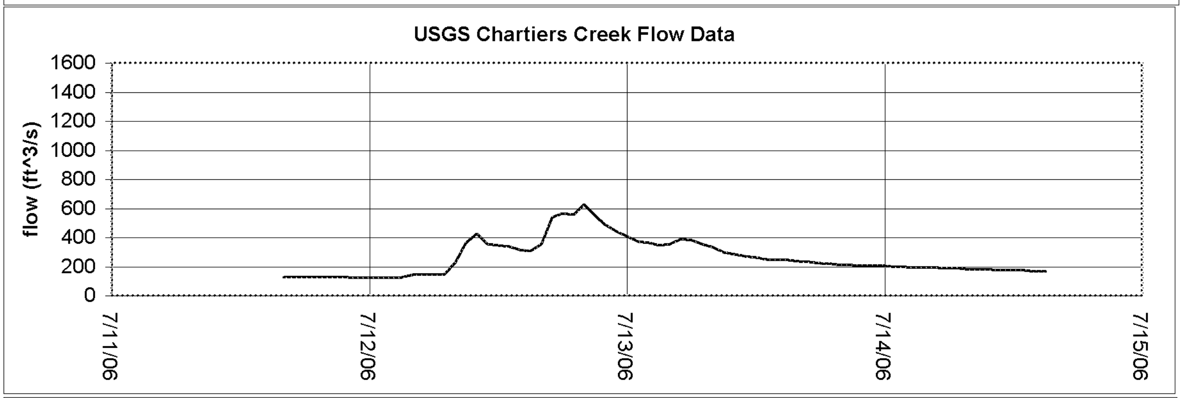


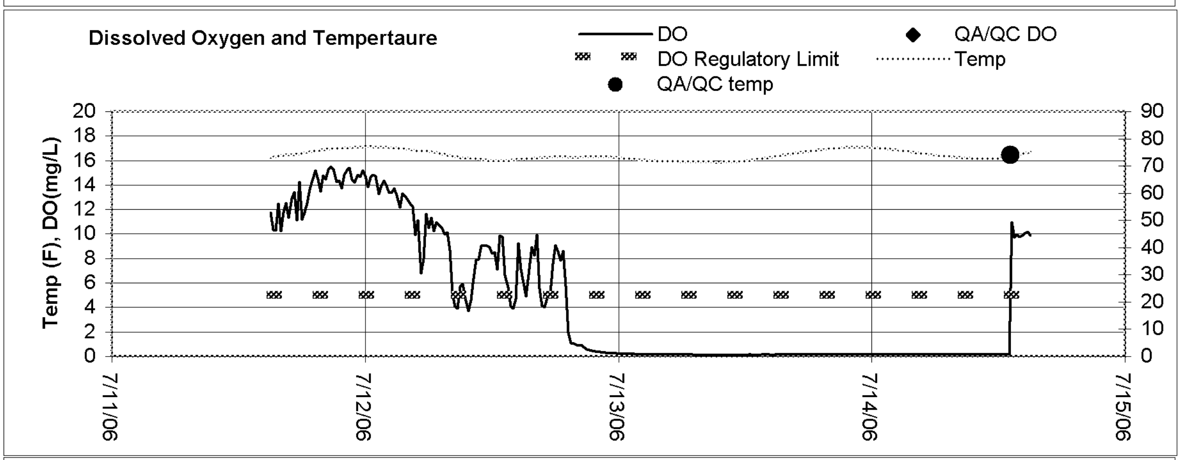


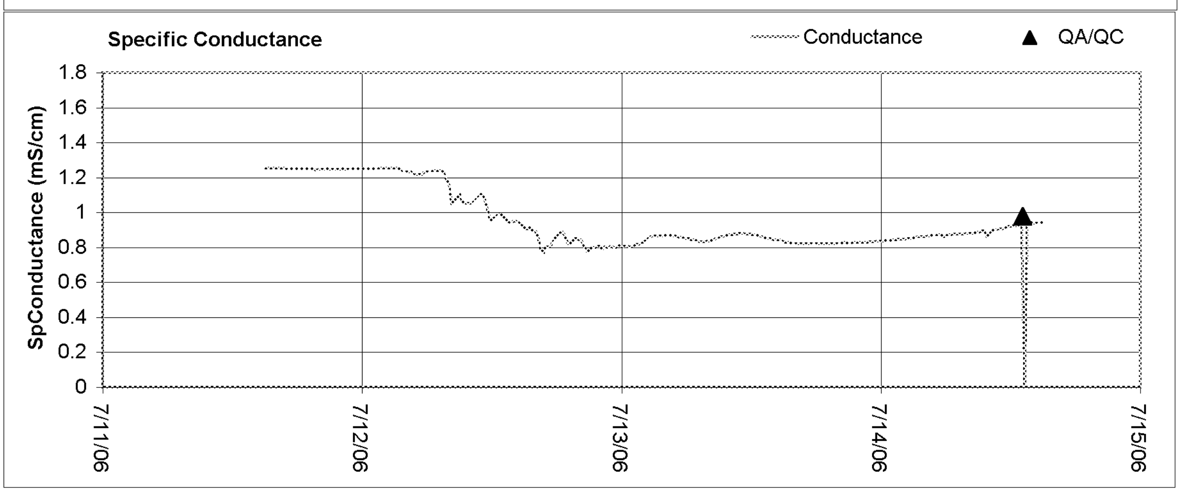


Chartiers Creek 1









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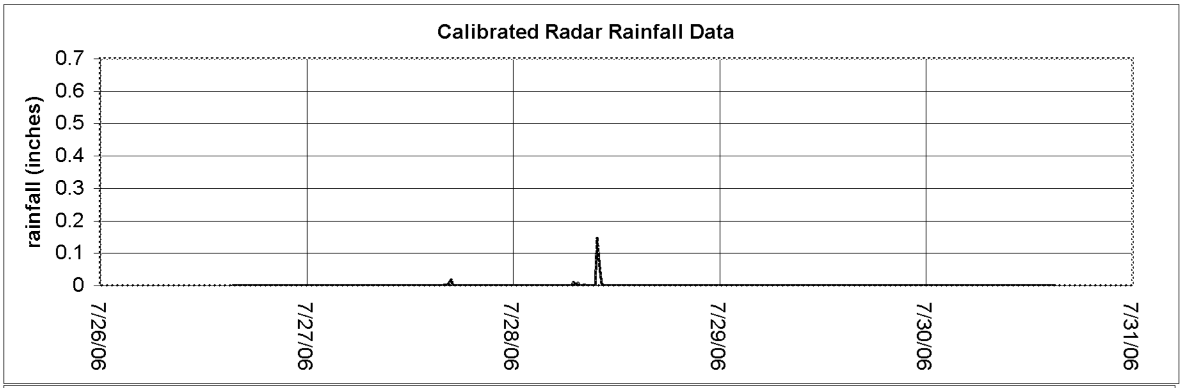

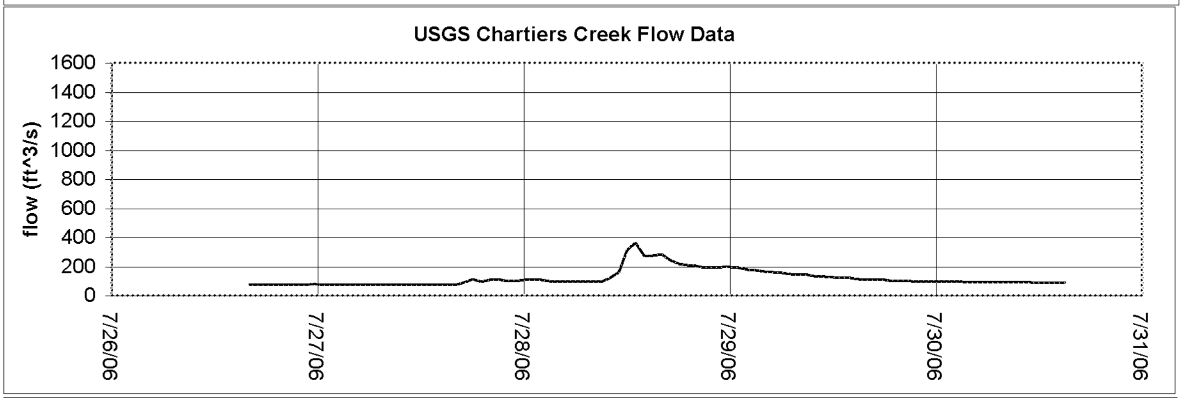

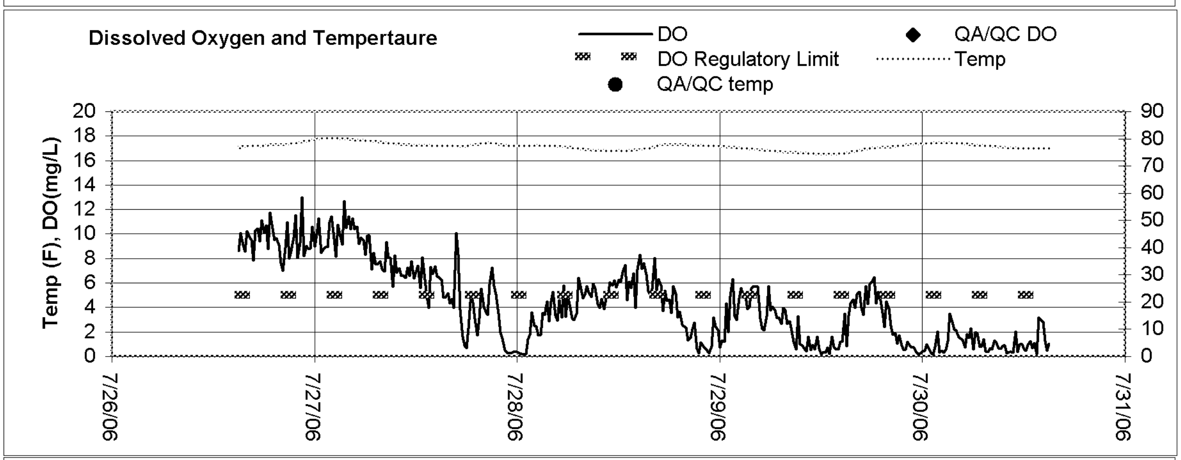

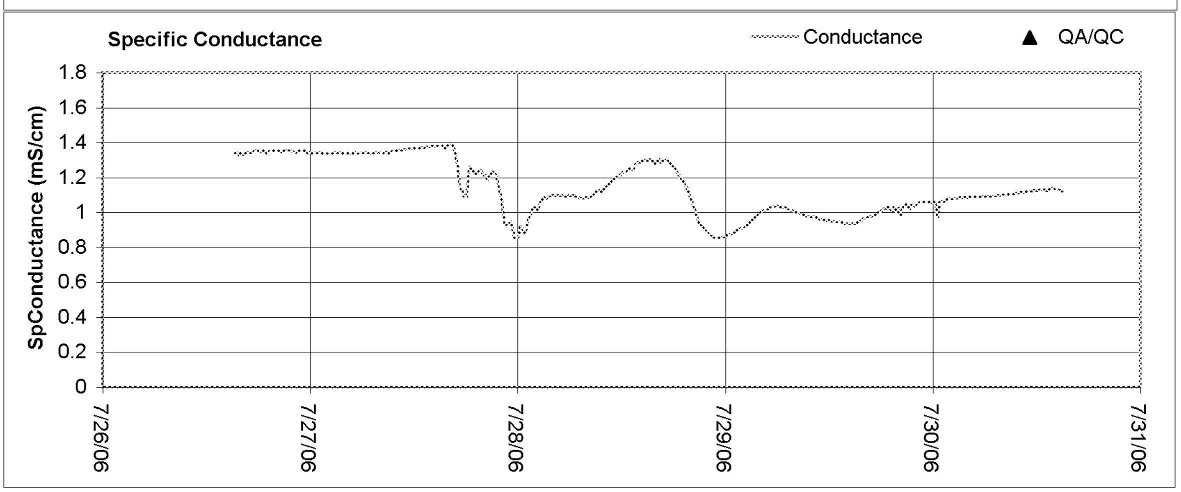

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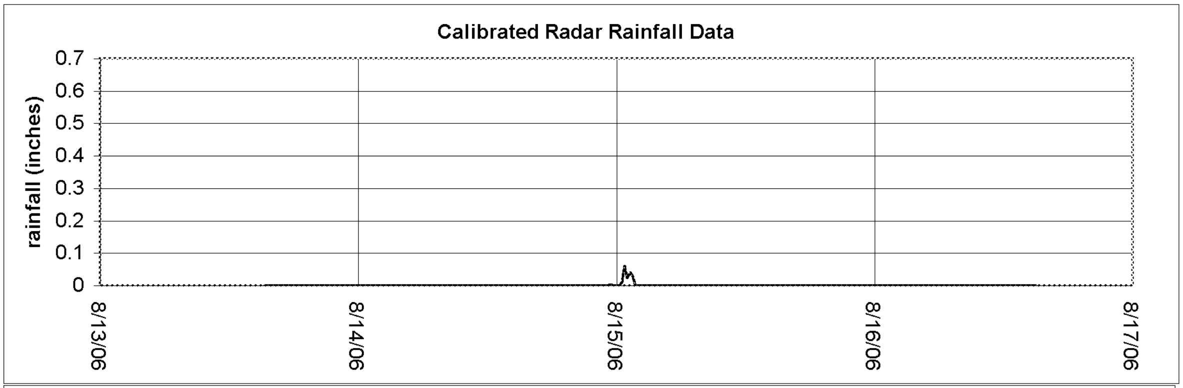
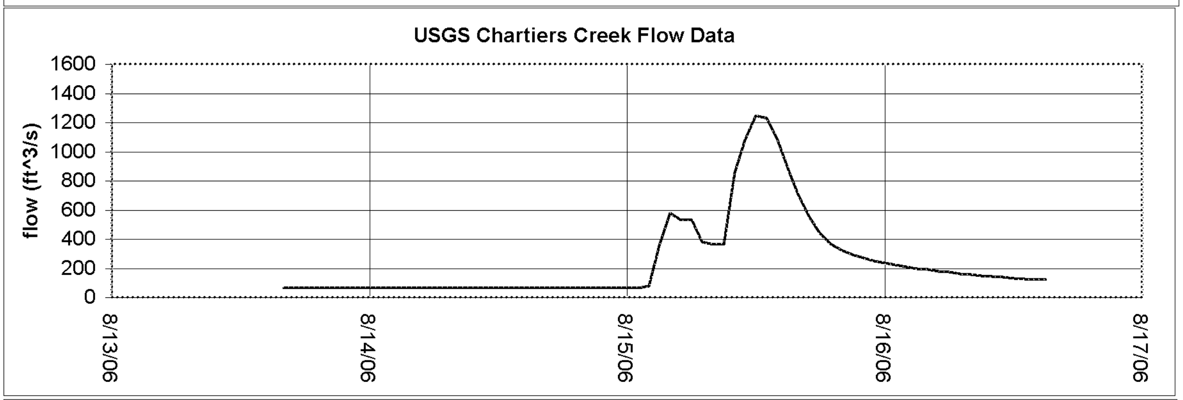
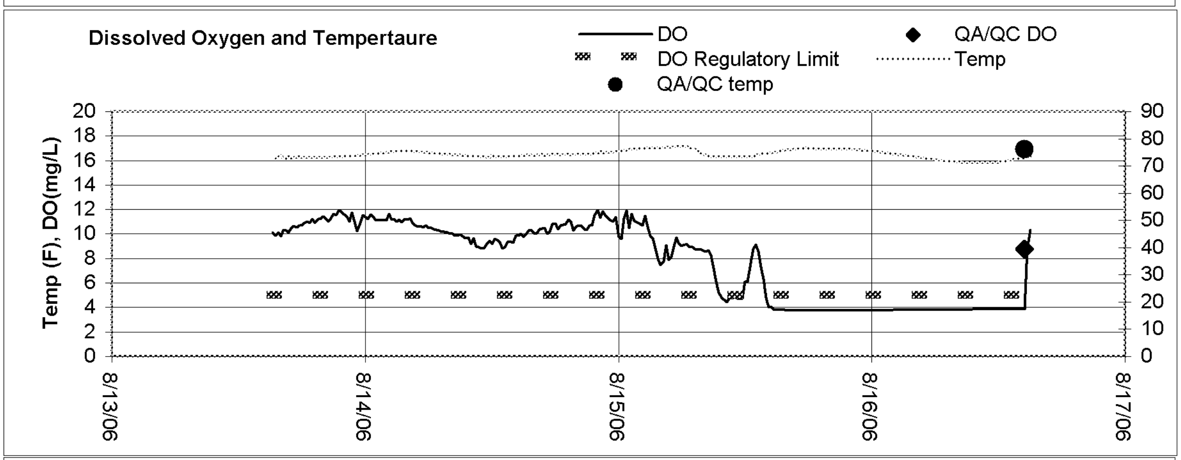
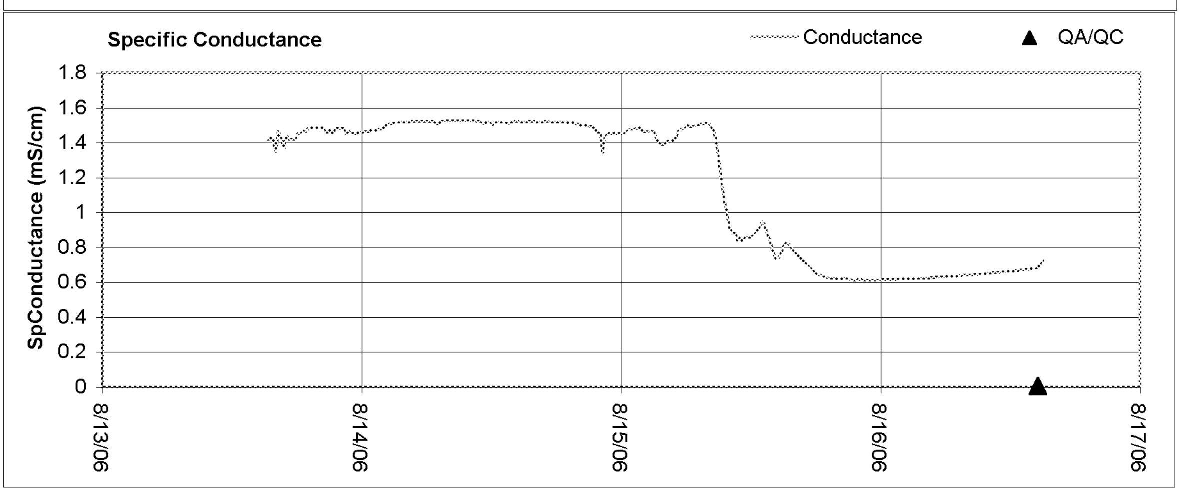
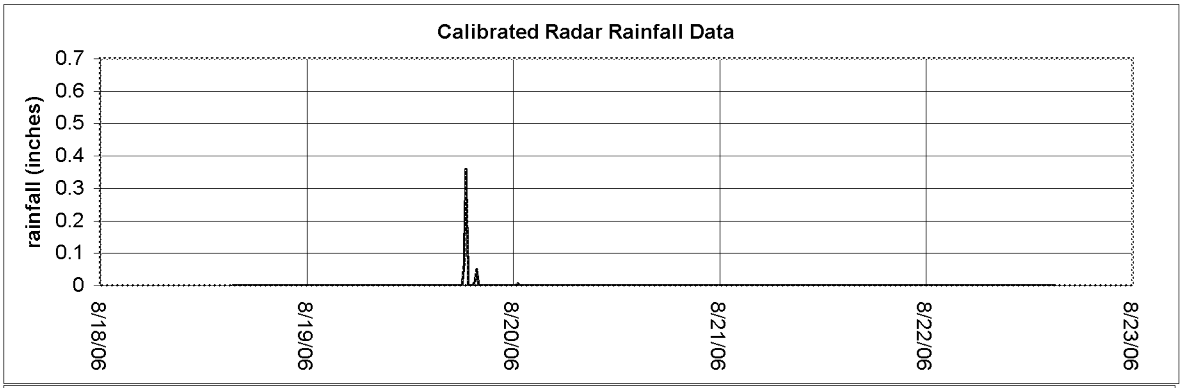


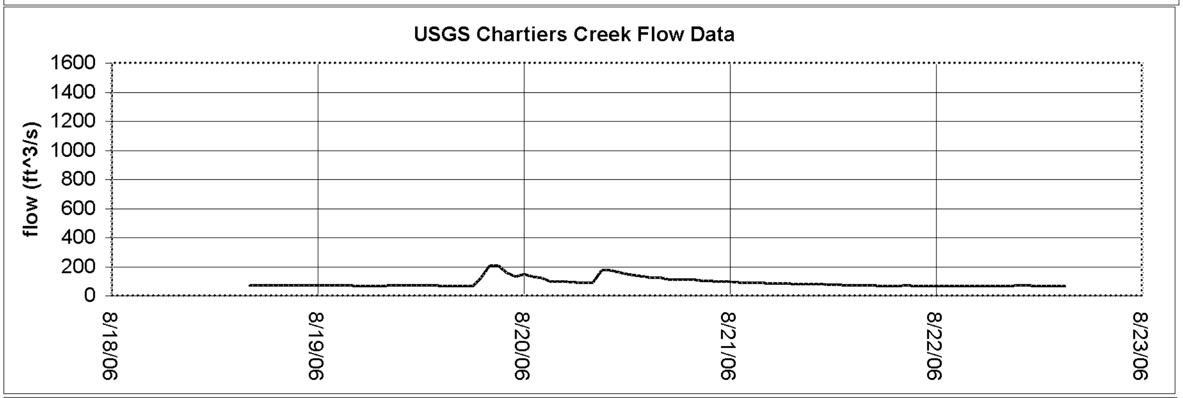


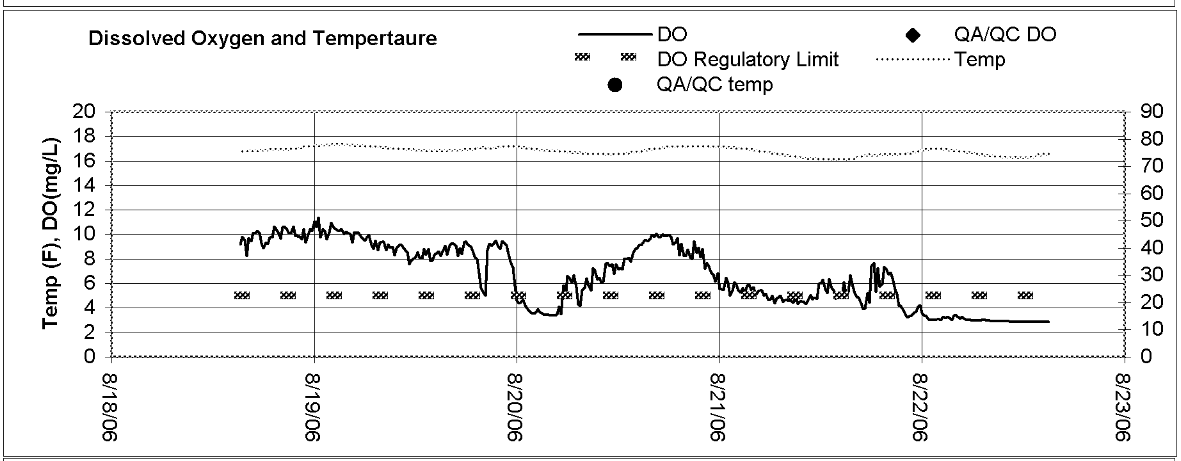


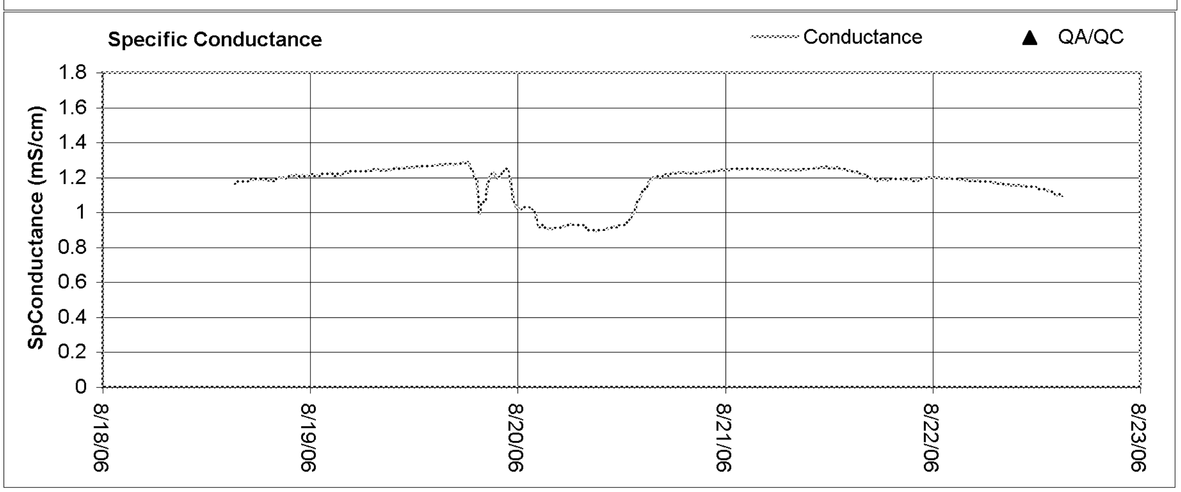


Chartiers Creek 1

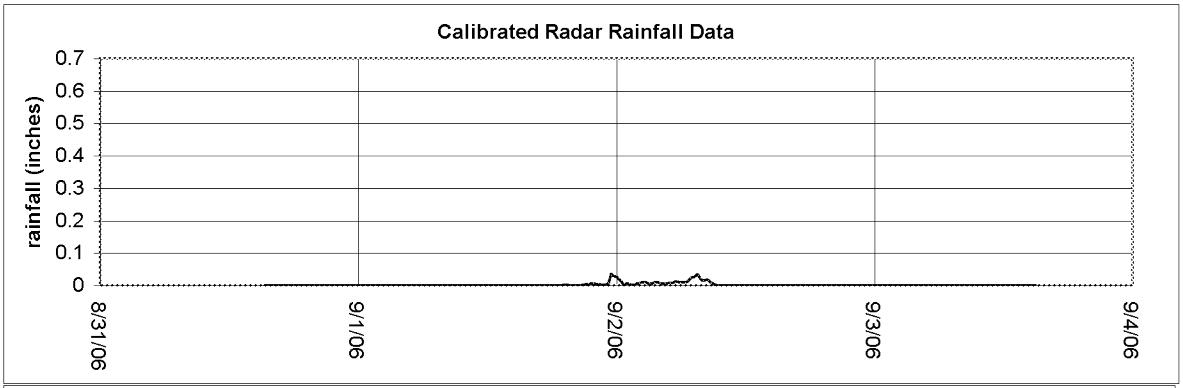


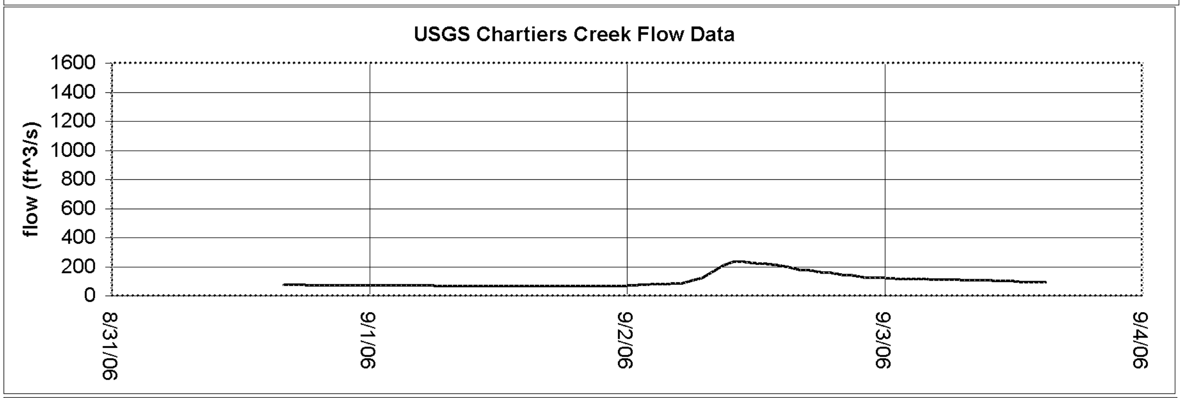


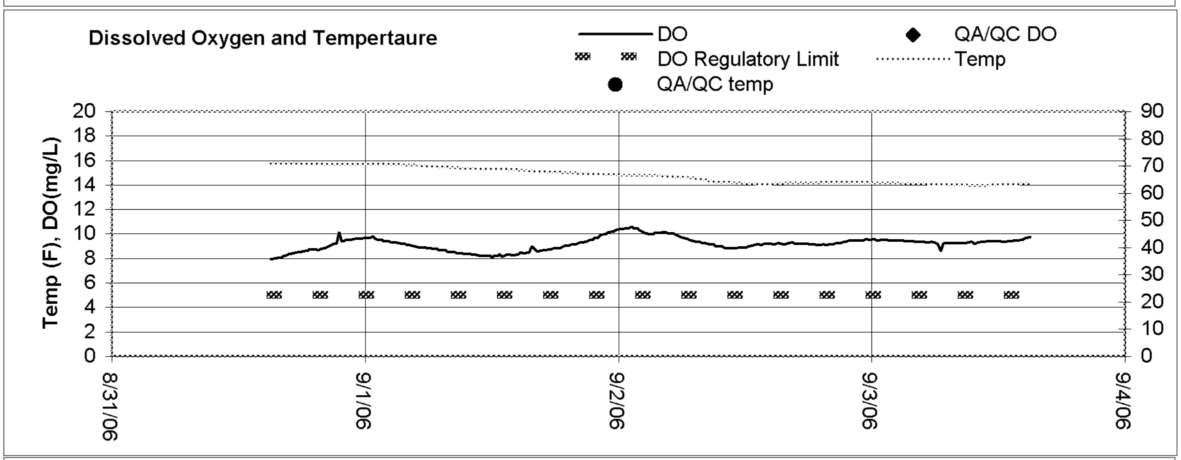


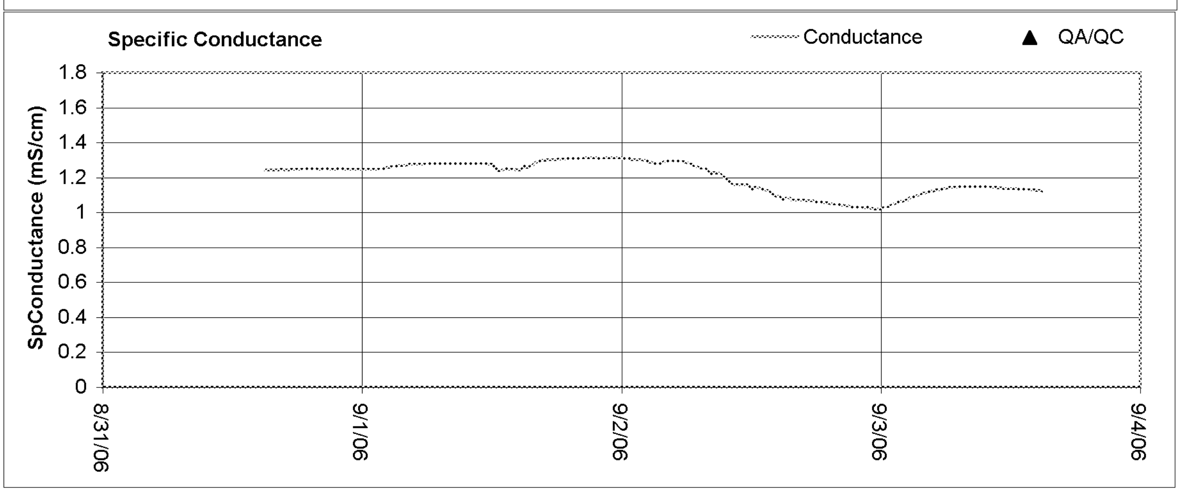


Chartiers Creek 1

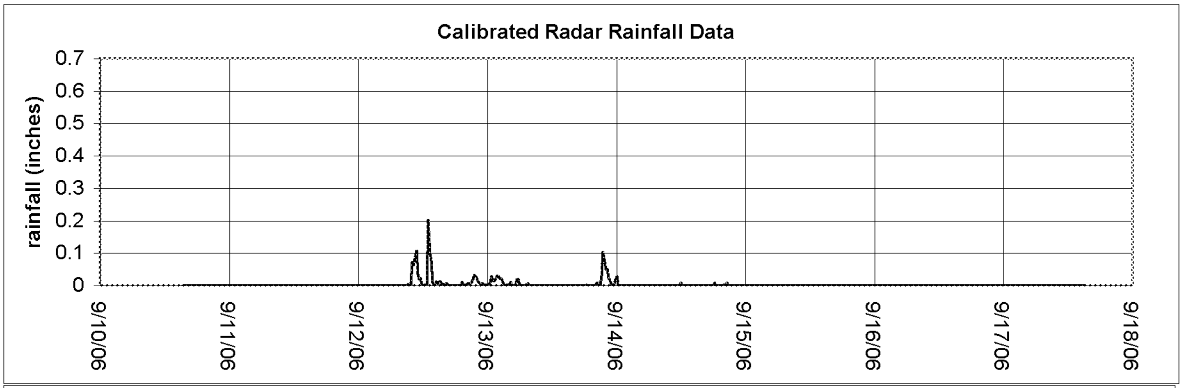


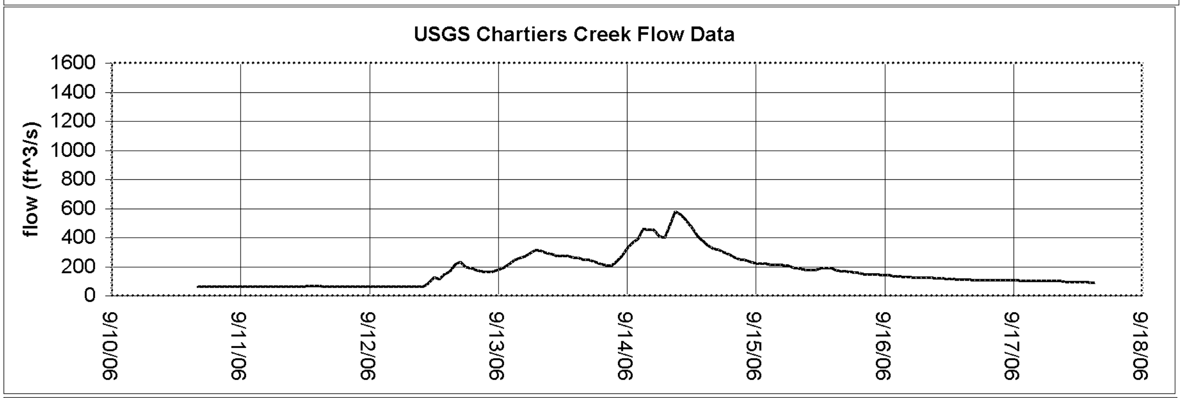


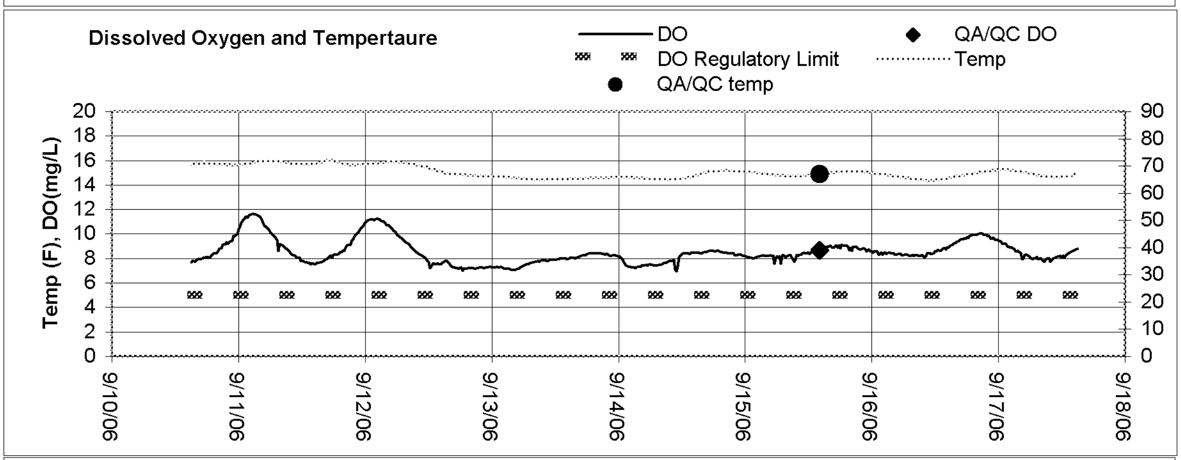


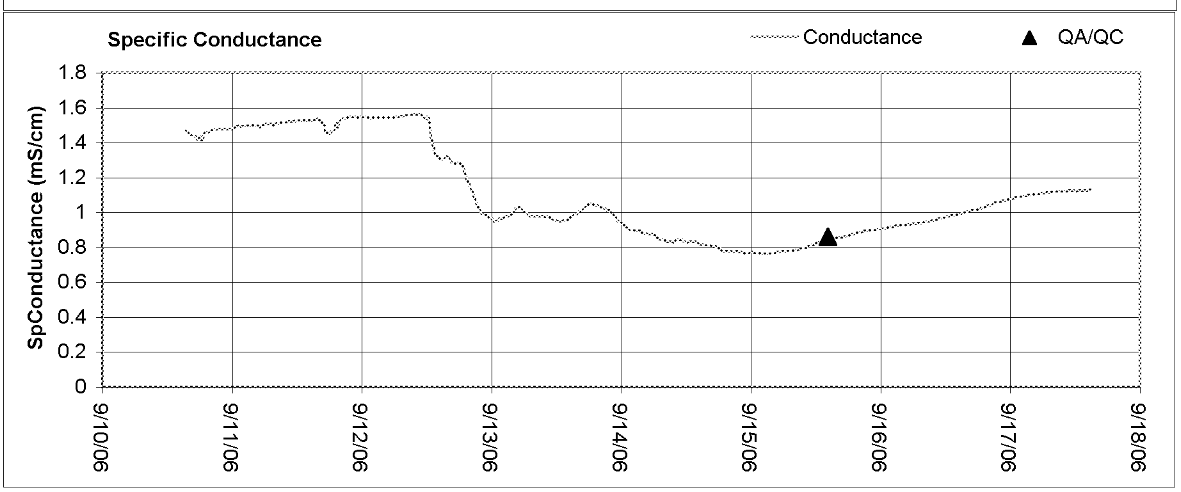


Chartiers Creek 1
(Probable CSO)









CHARTIERS CREEK (CC-SW-2)
WET WETHER DATA GRAPHS

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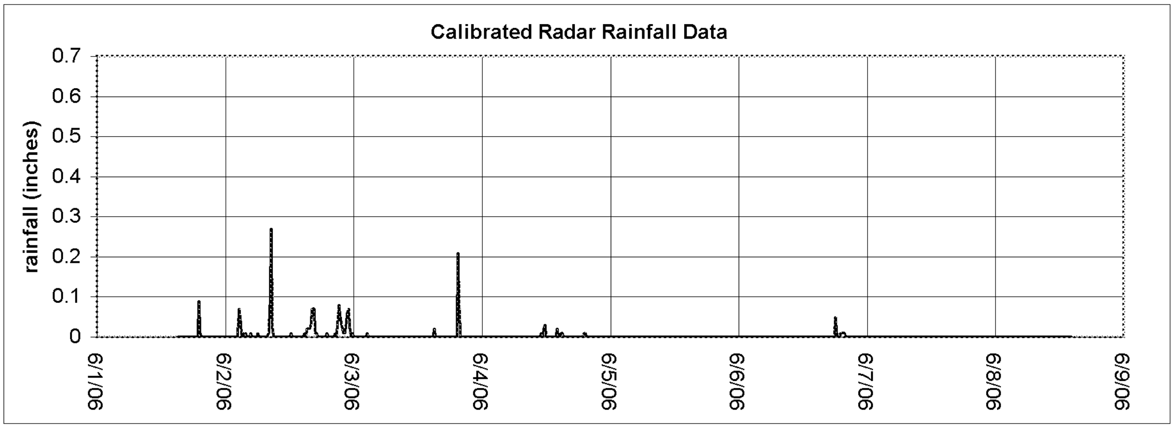
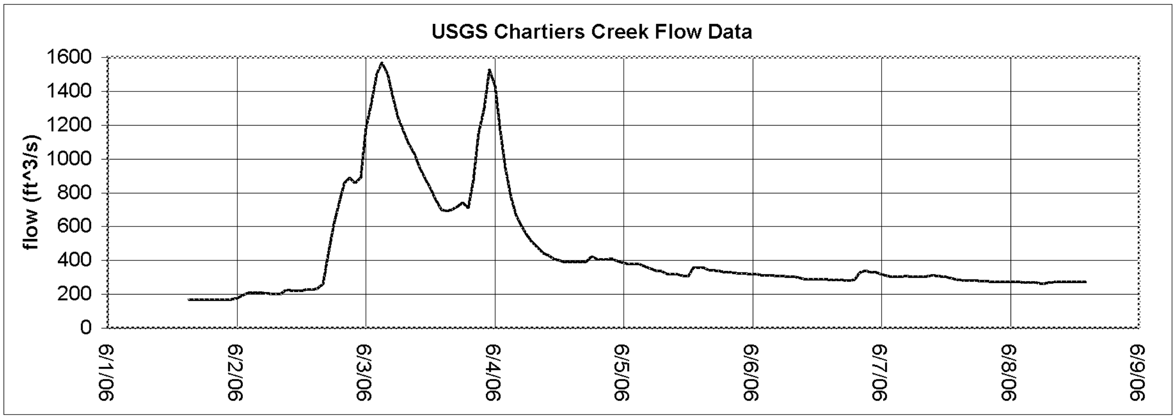
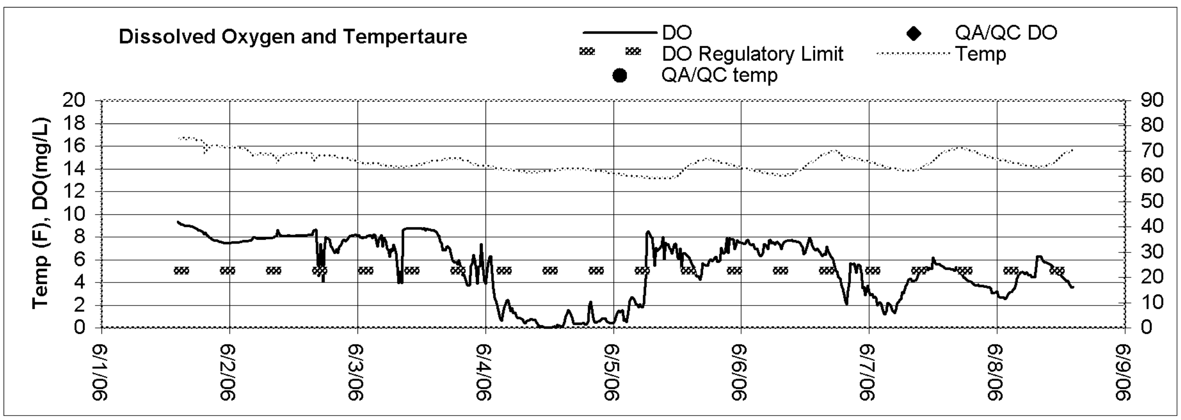
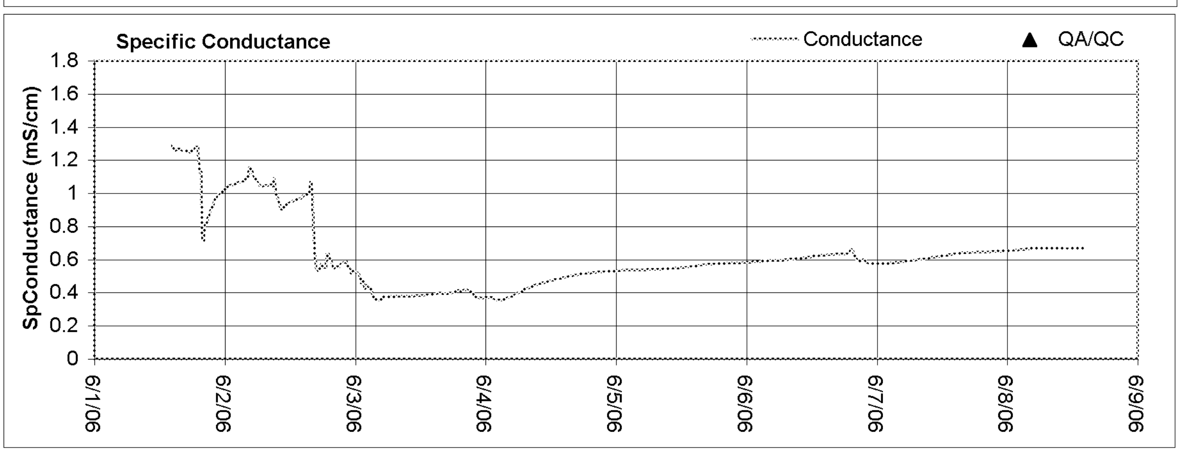
(Probable CSO)









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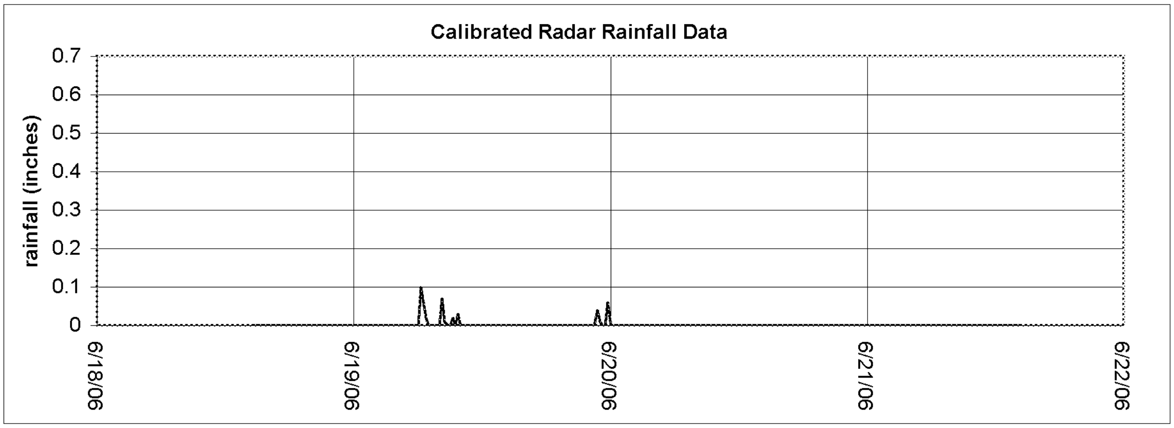

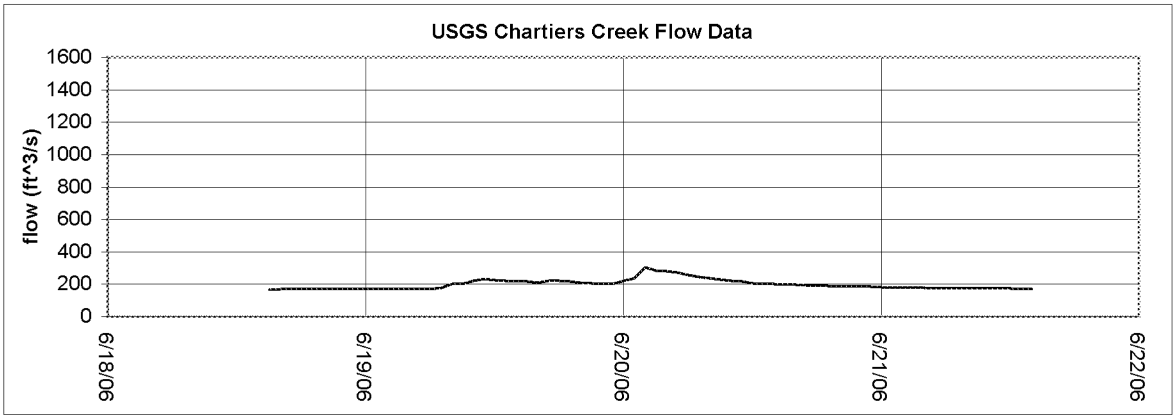

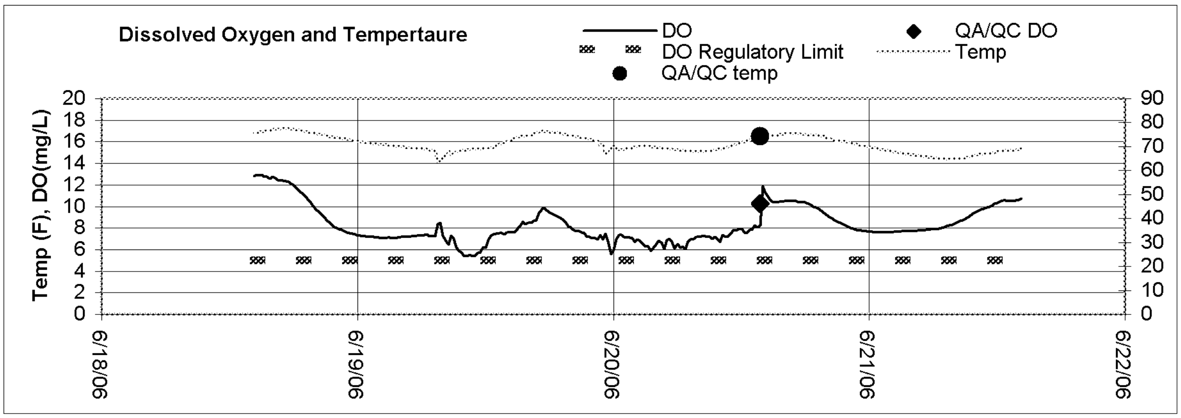

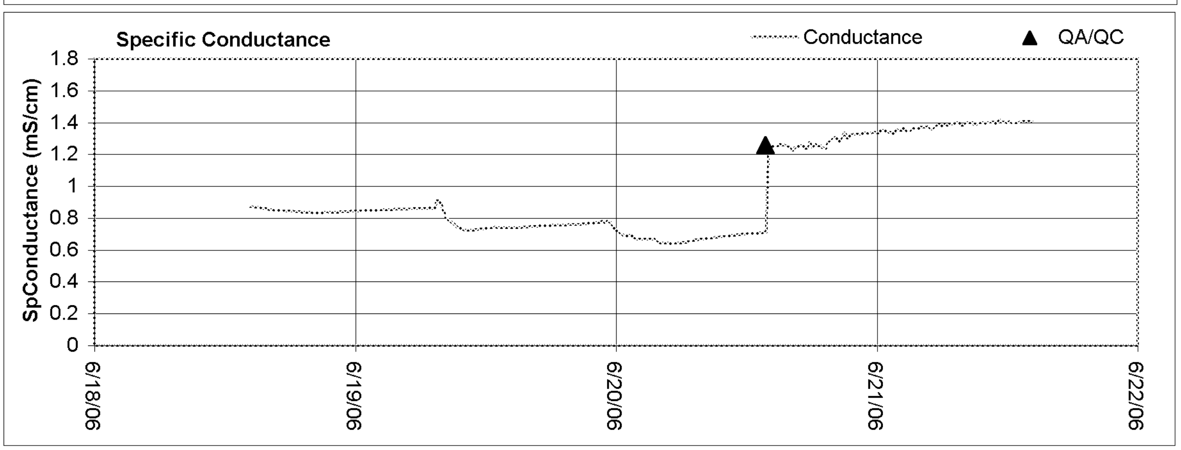

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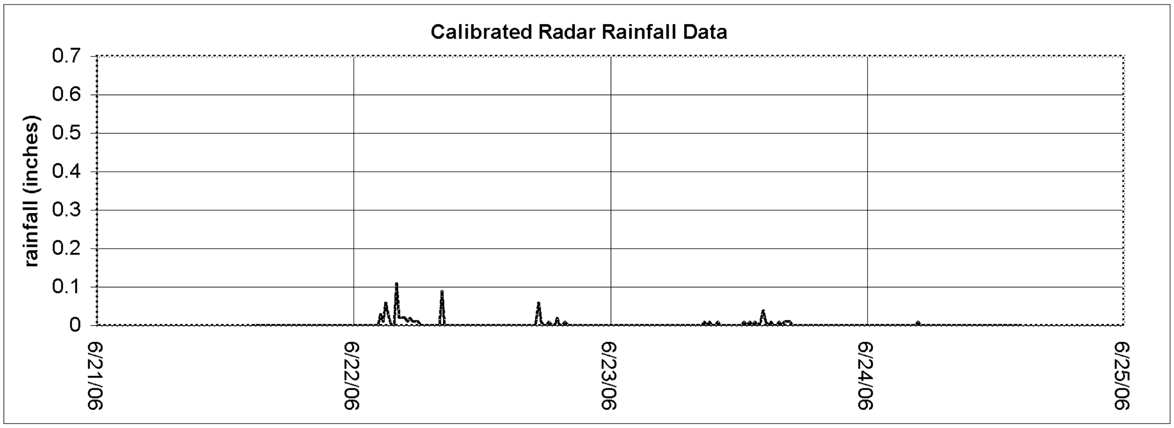

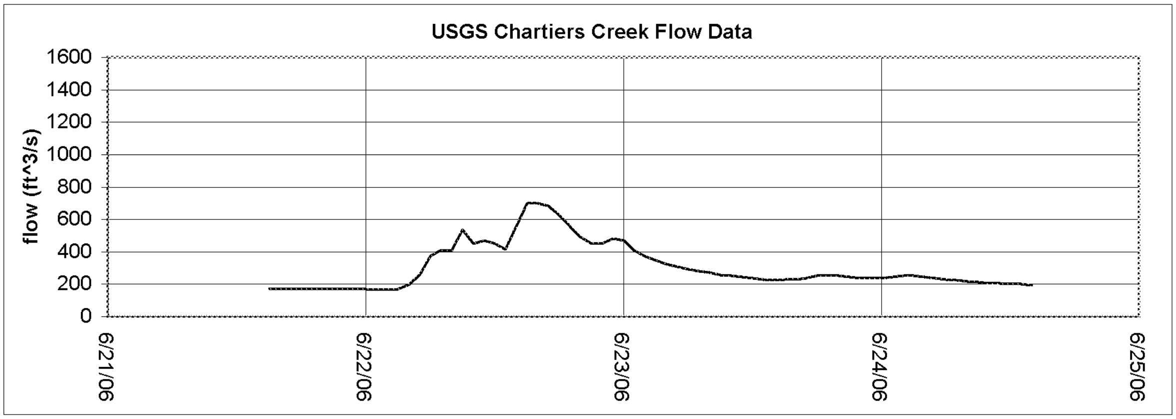

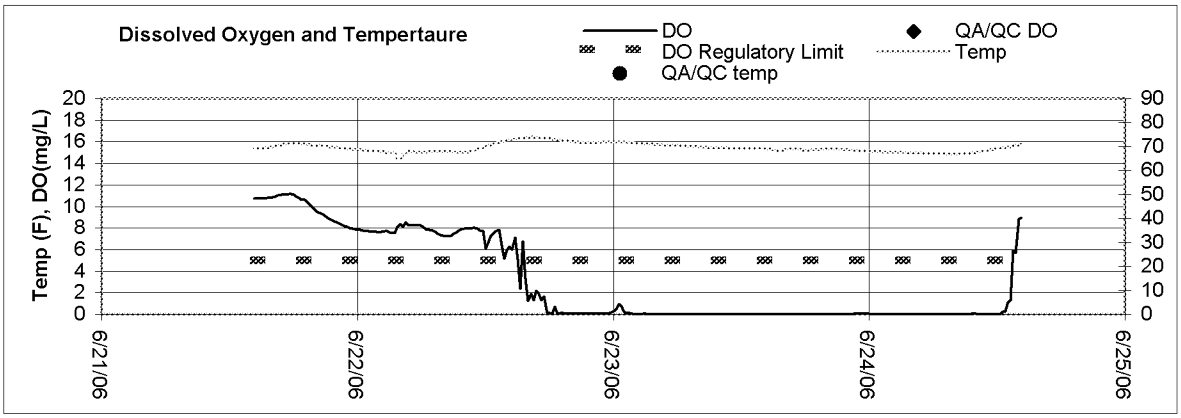

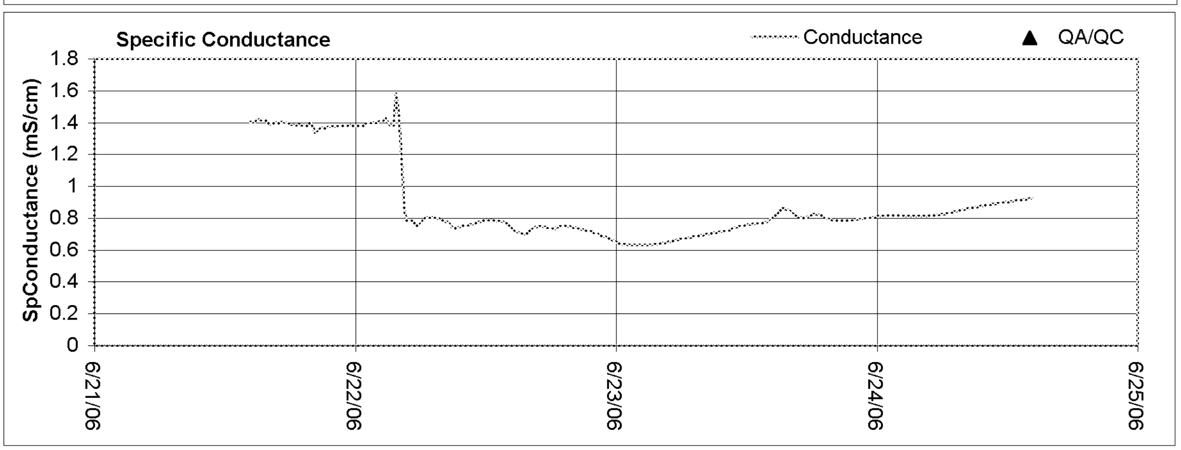

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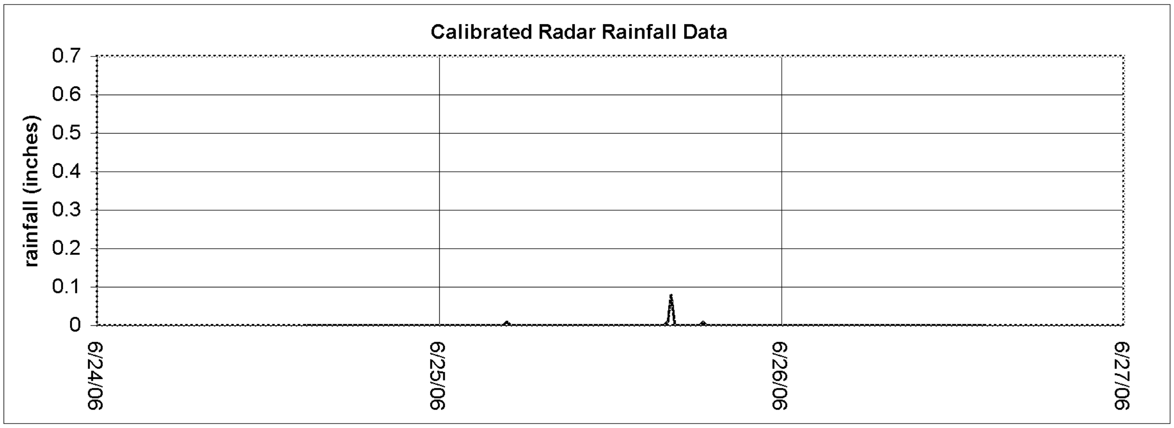

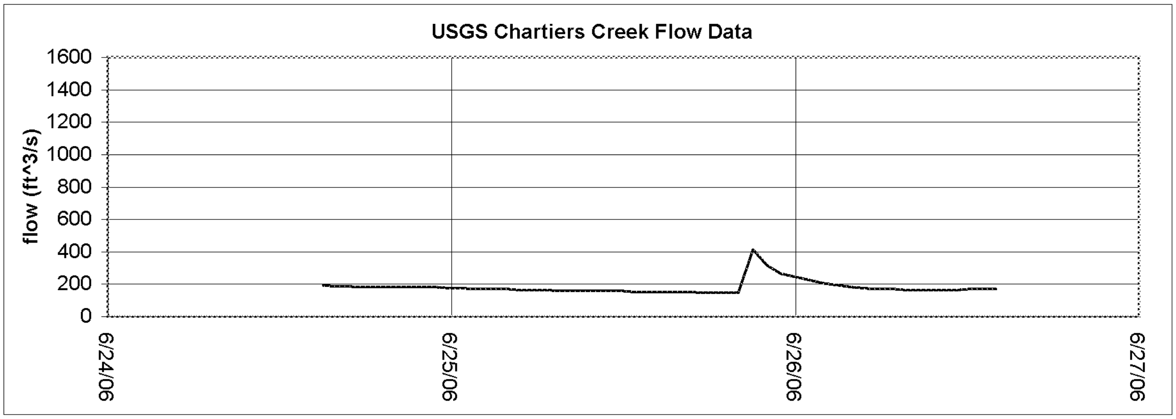

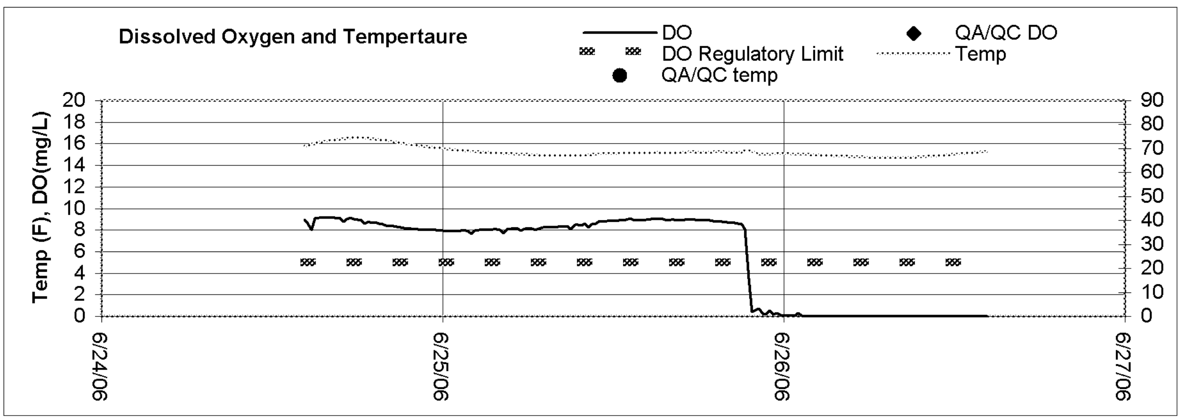

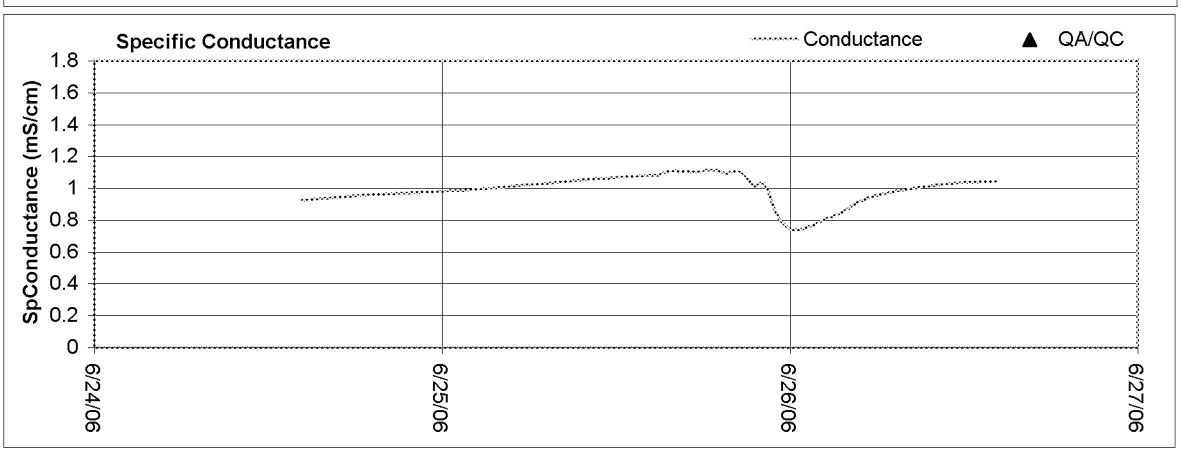

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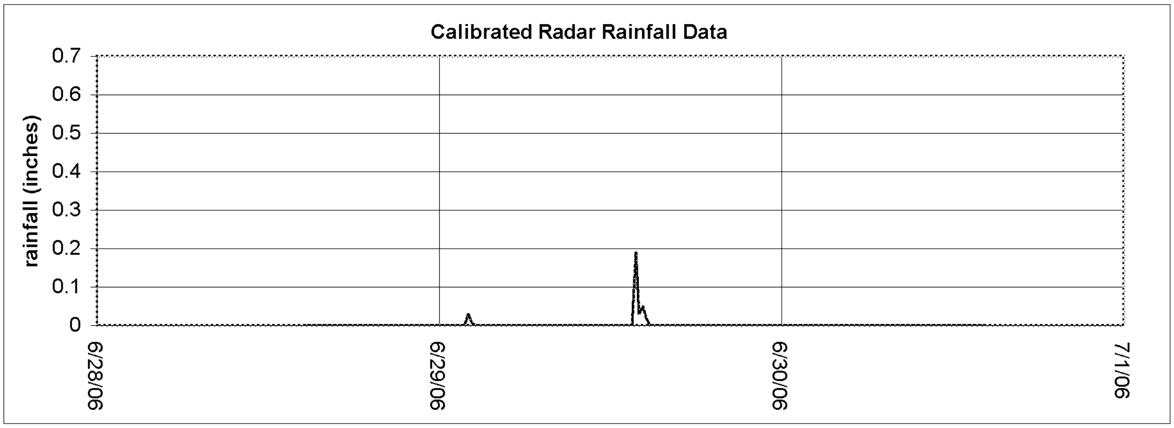

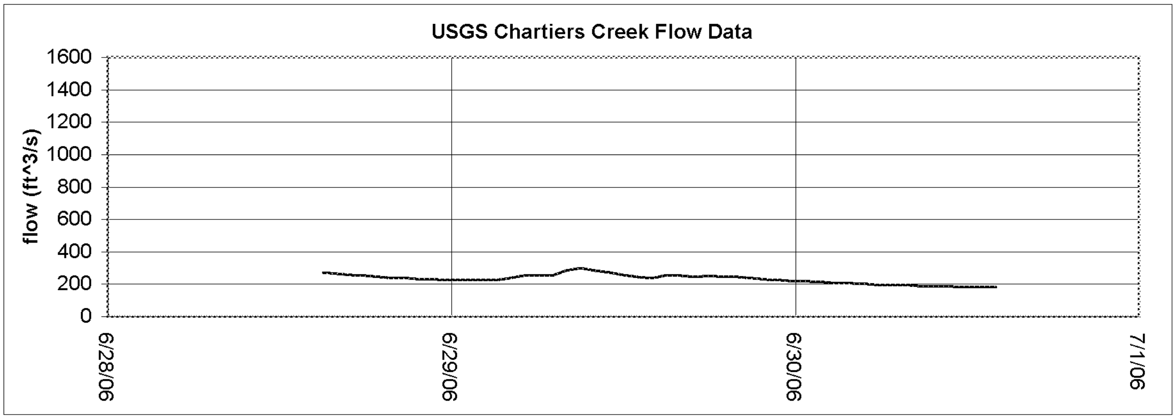

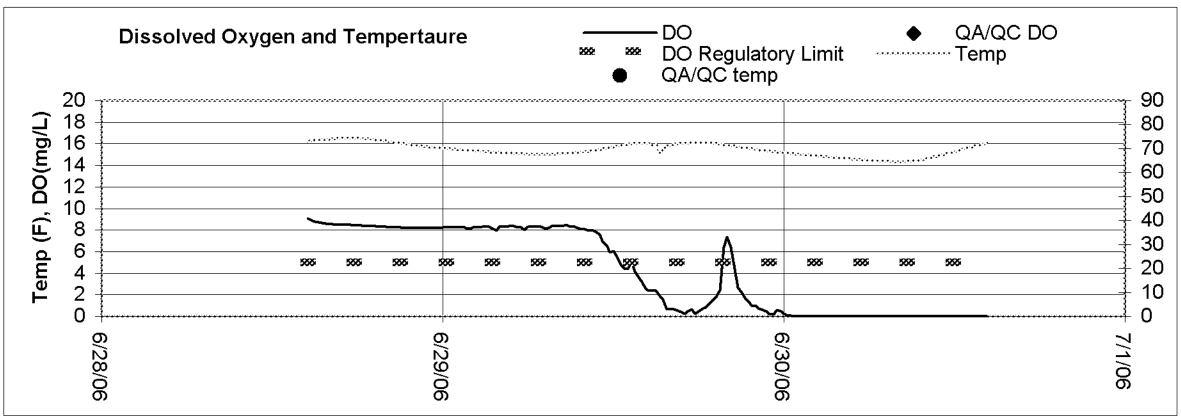

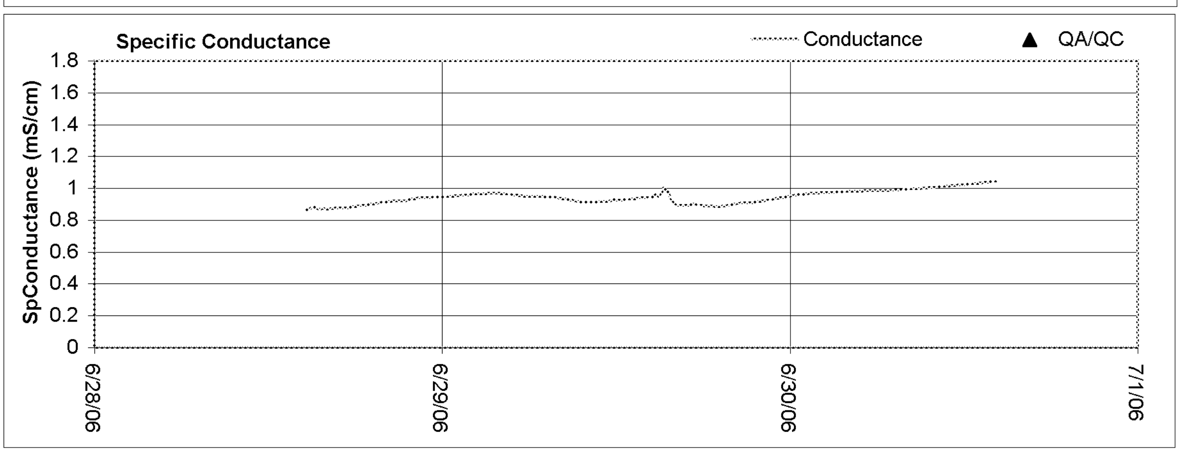

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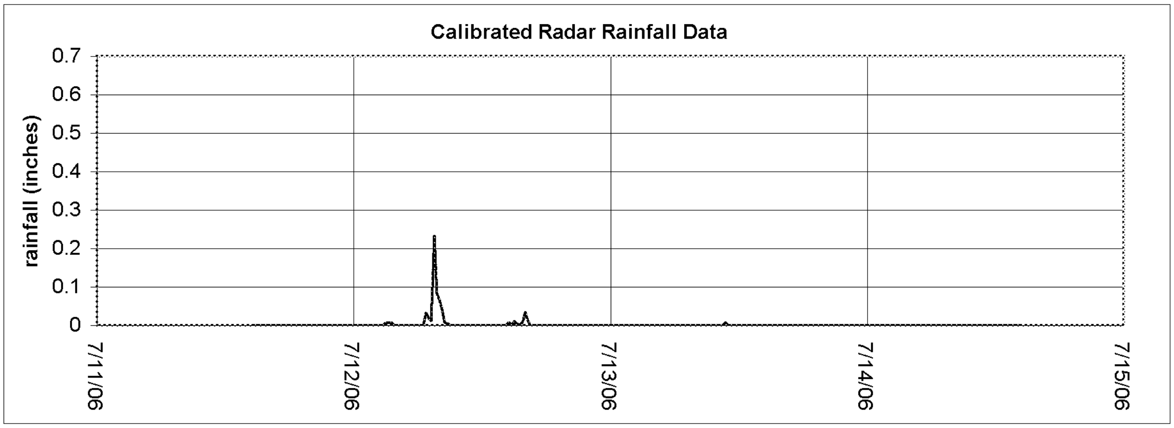

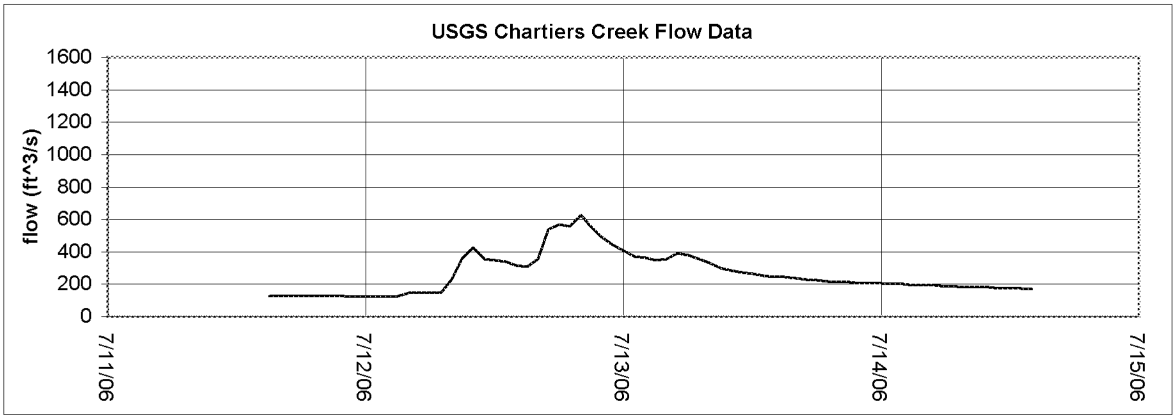

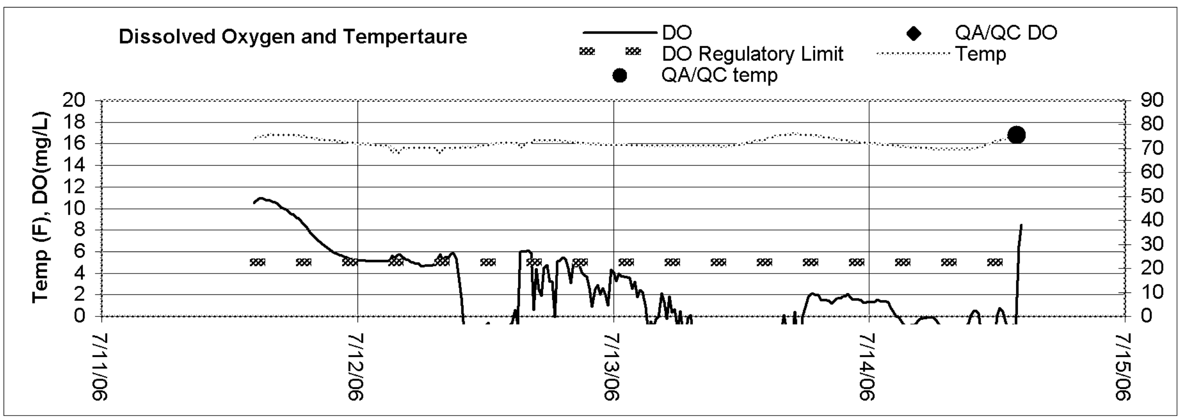

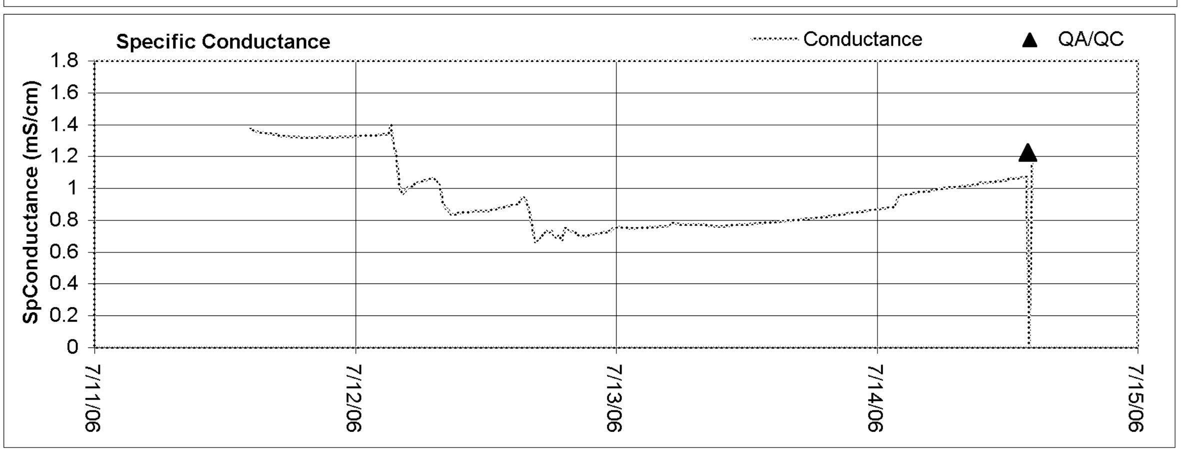

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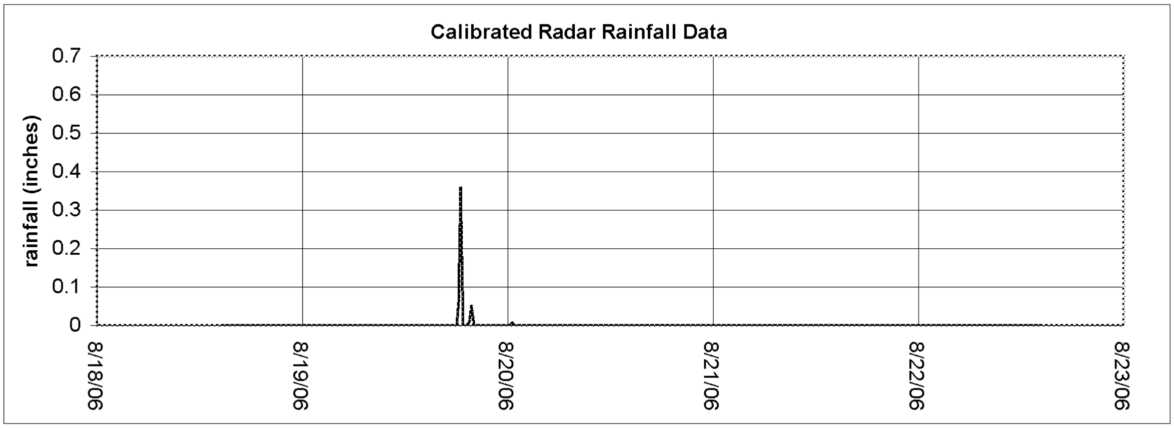

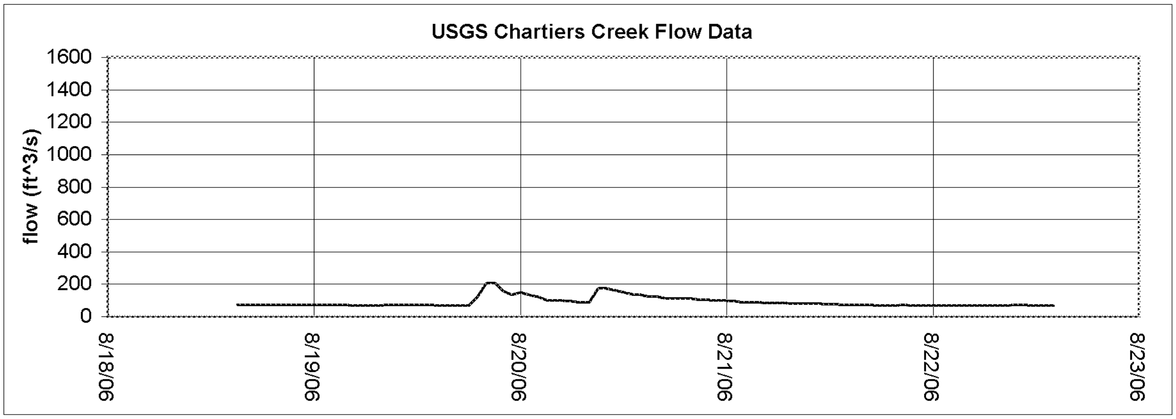

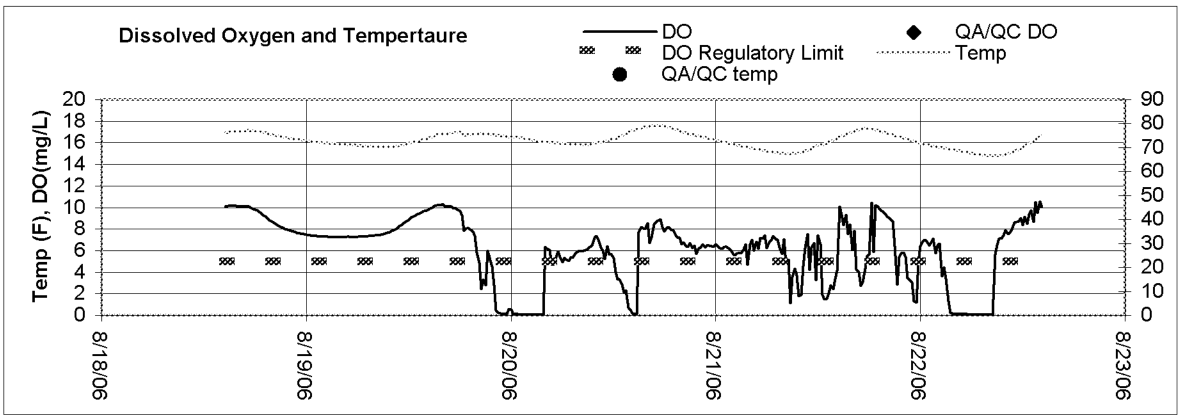

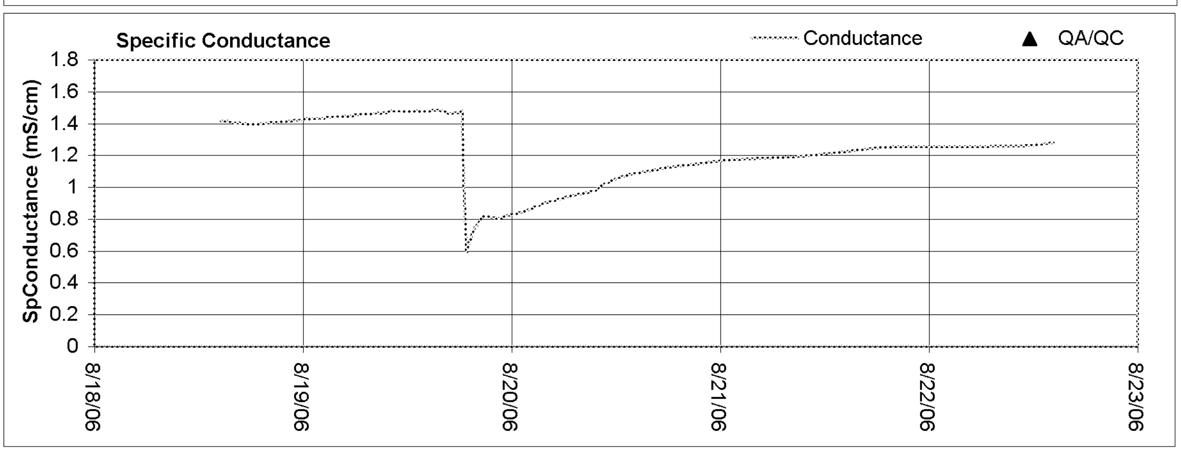

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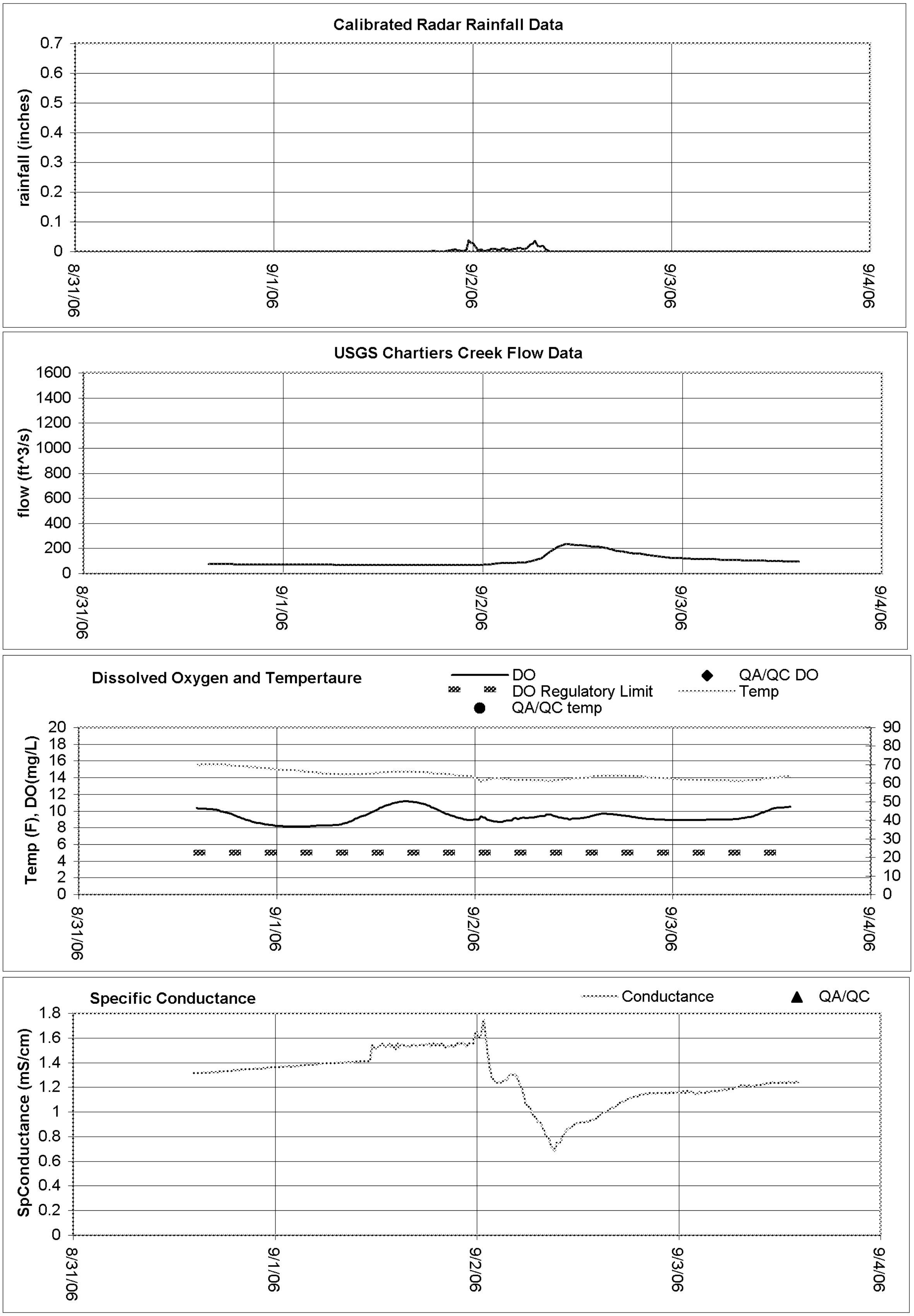
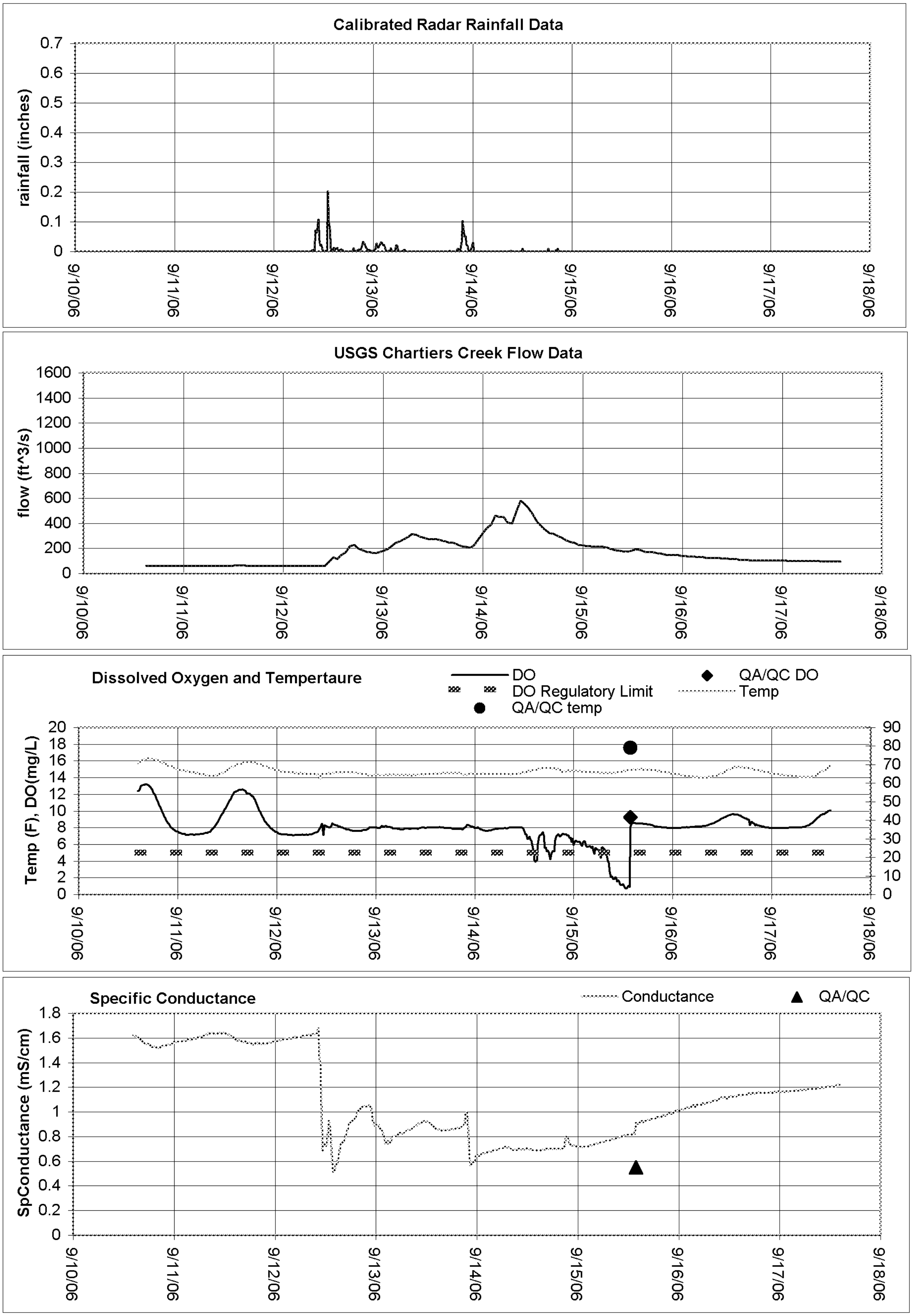
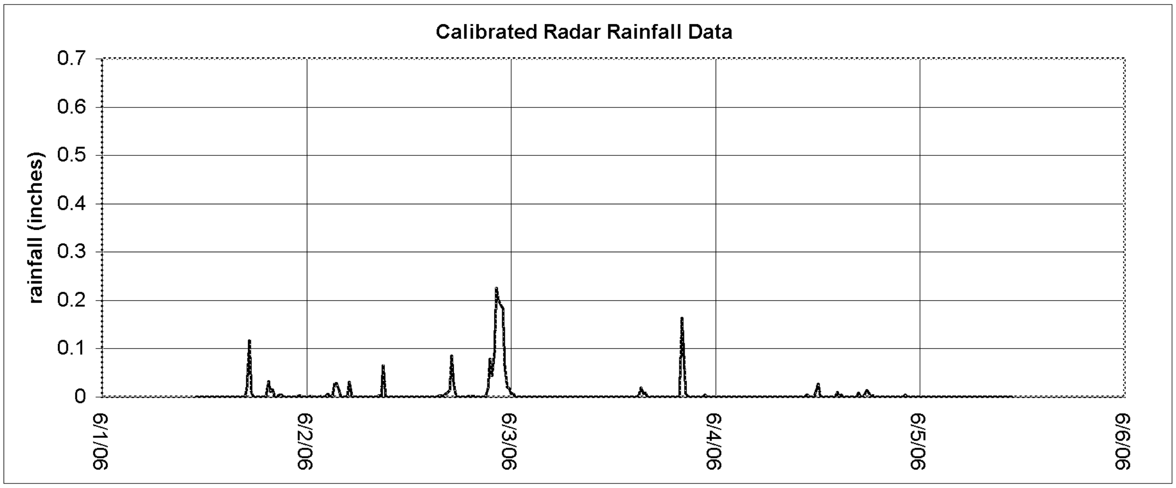


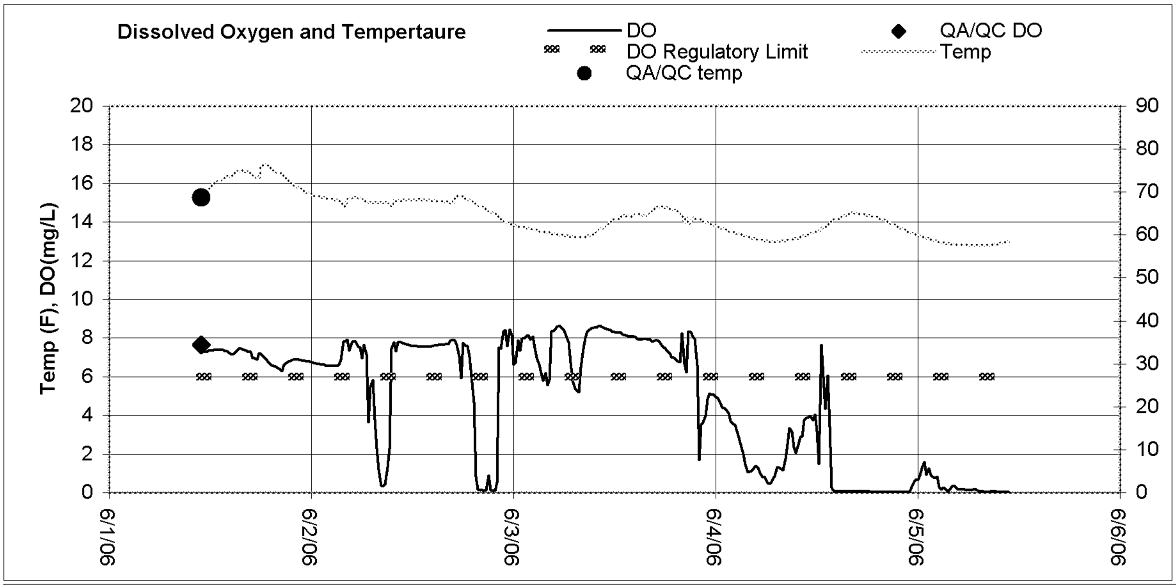
Chartiers Creek 2
(Probable CSO)

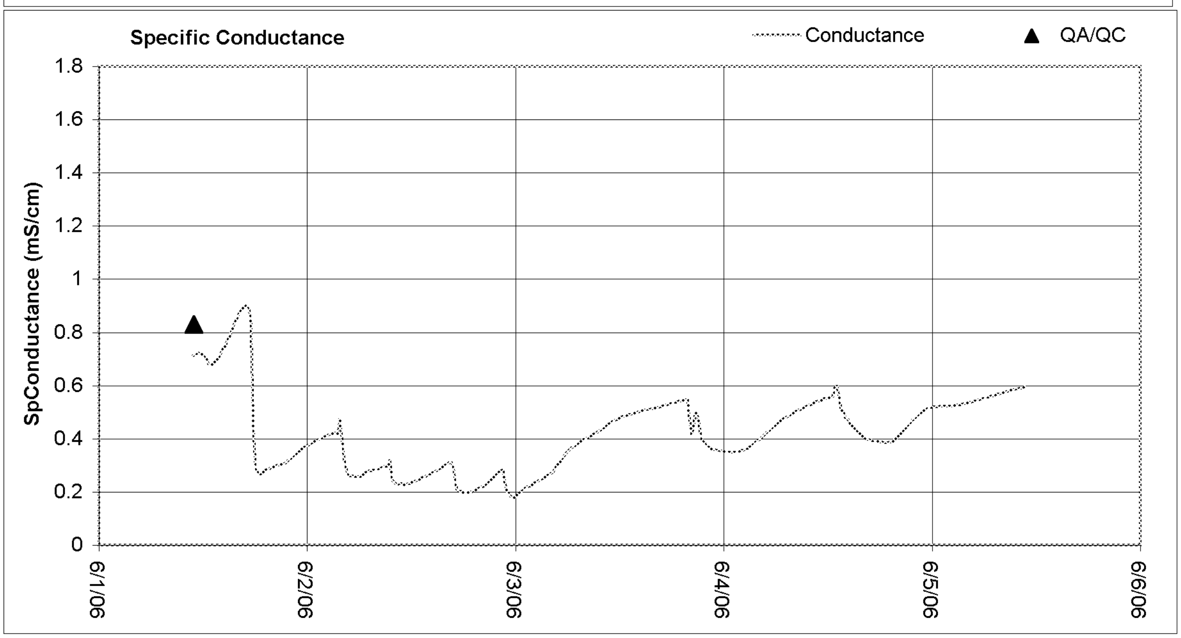


NINE MILE RUN (NM-SW-1)
WET WETHER DATA GRAPHS

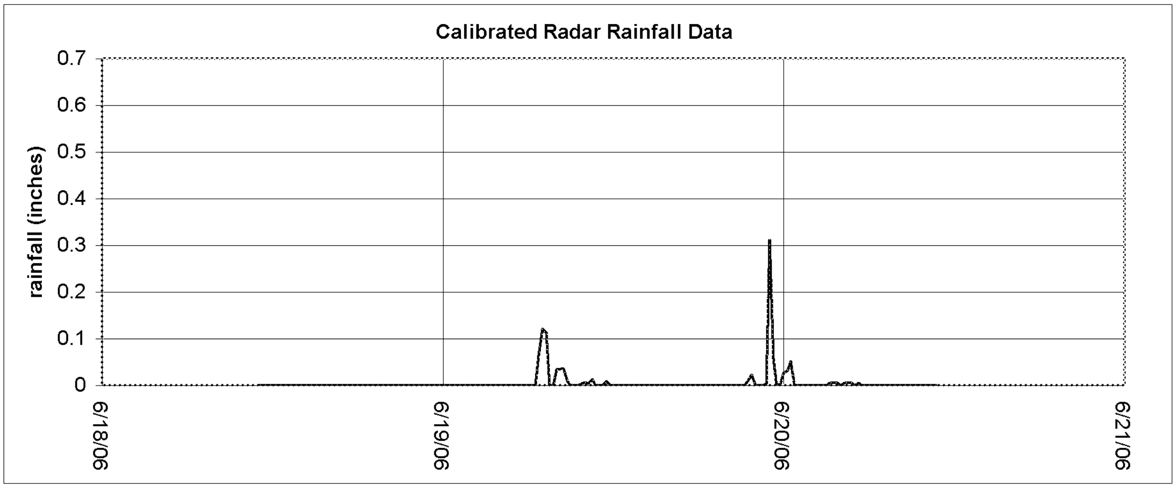
Nine Mile Run 1
(Probable CSO)

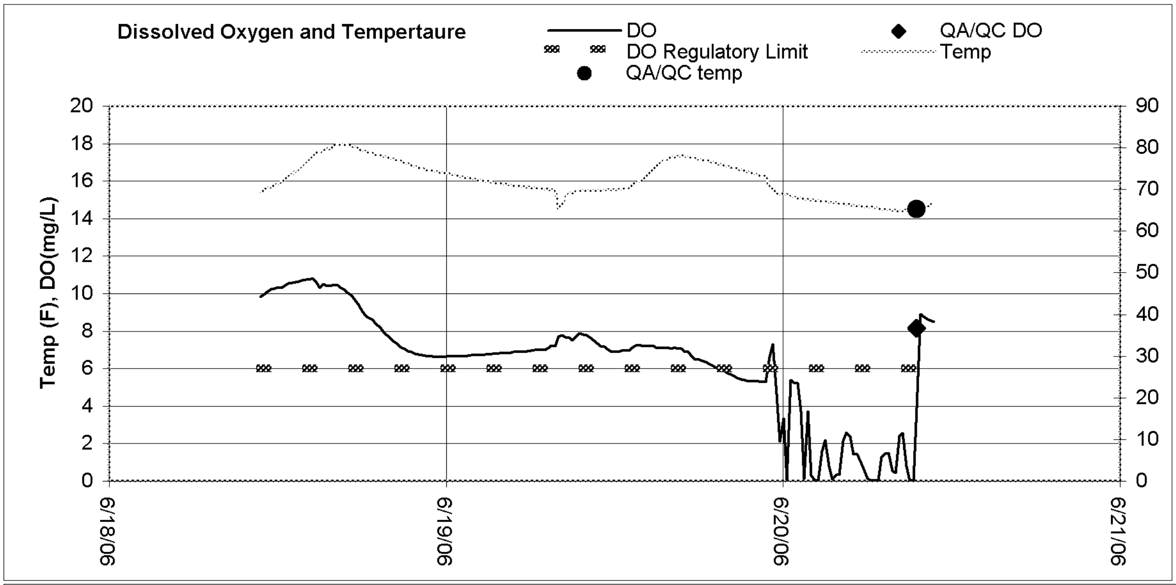


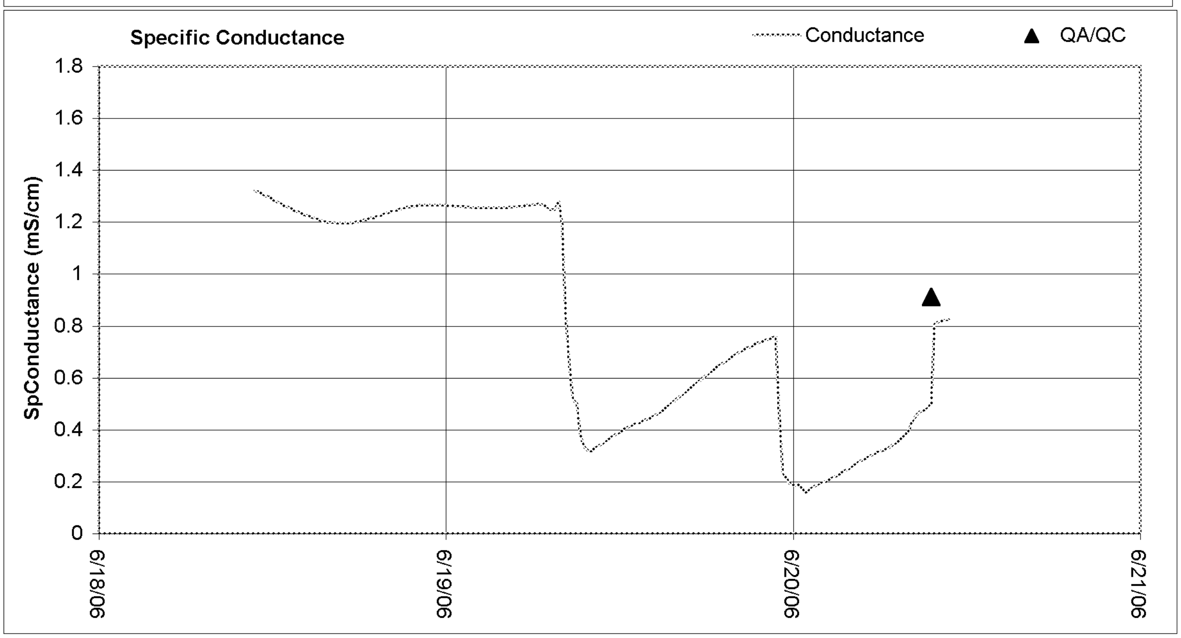




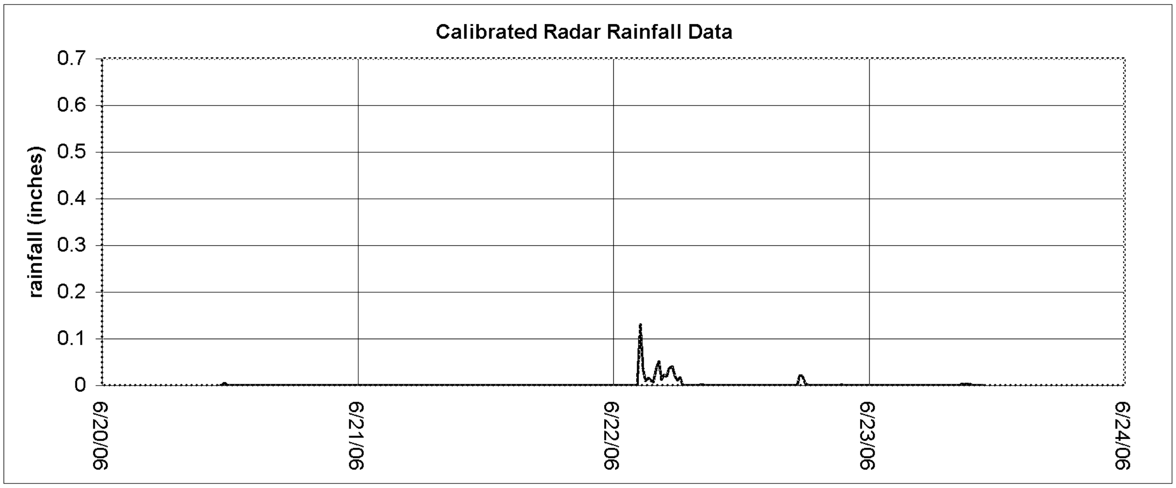
Nine Mile Run 1
(Probable CSO)

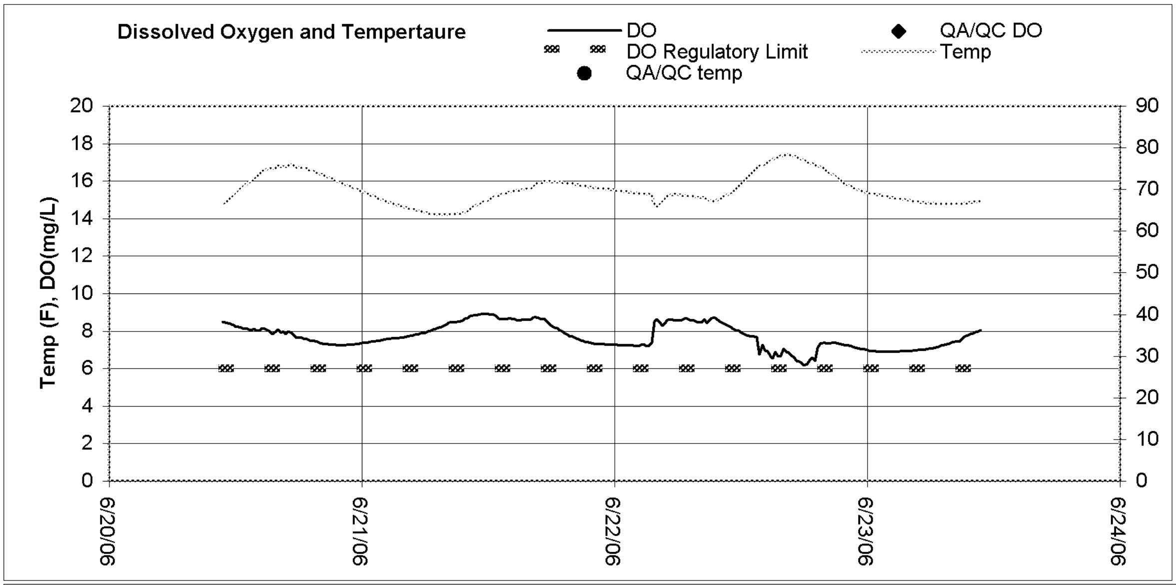


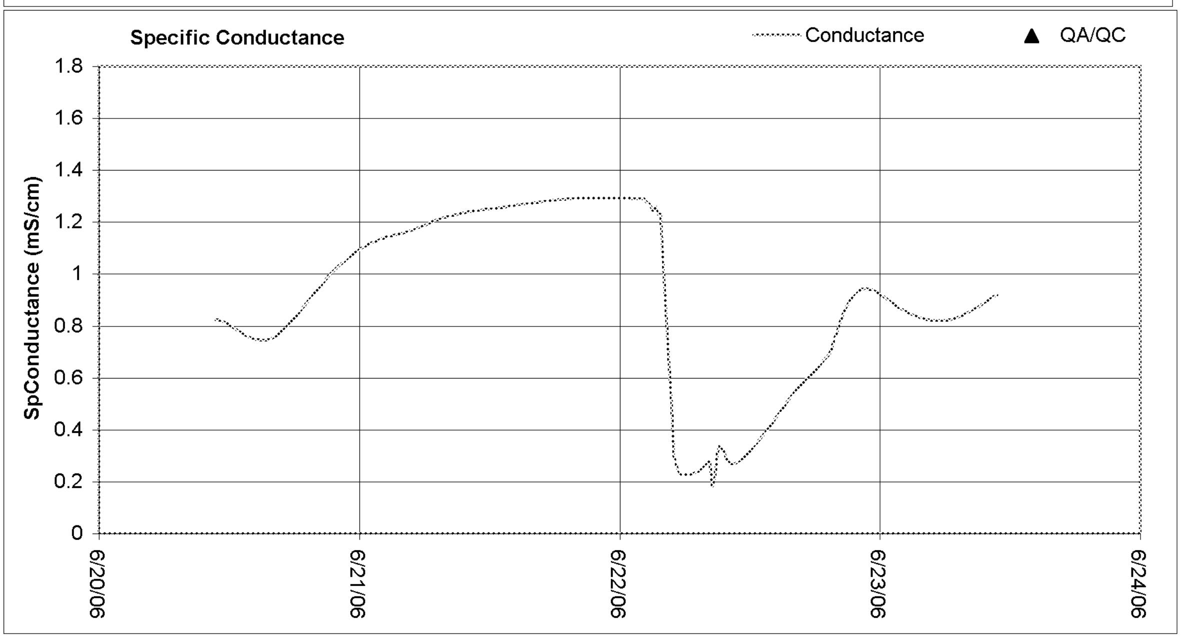




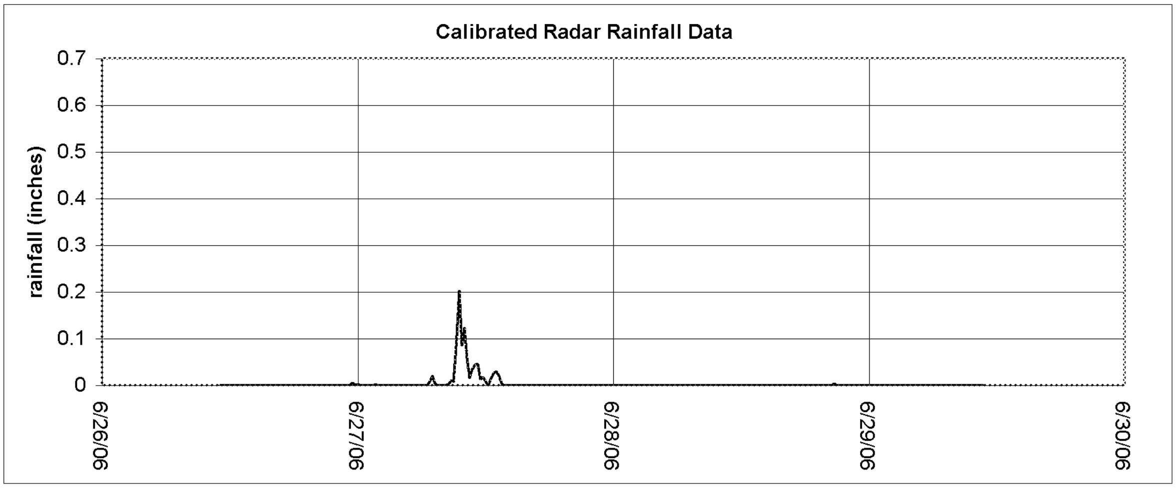
Nine Mile Run 1

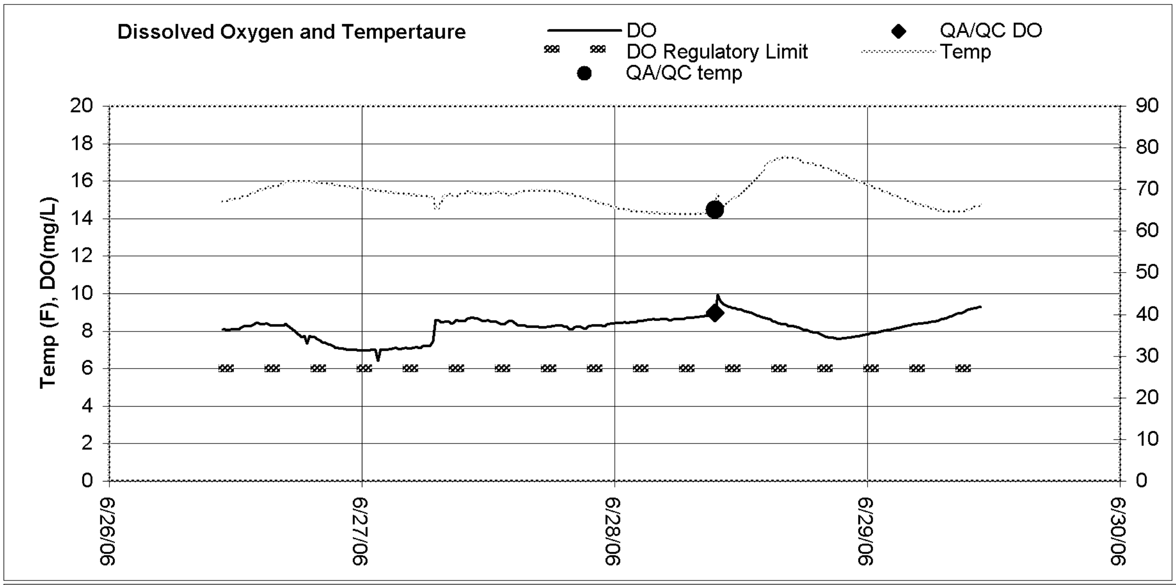


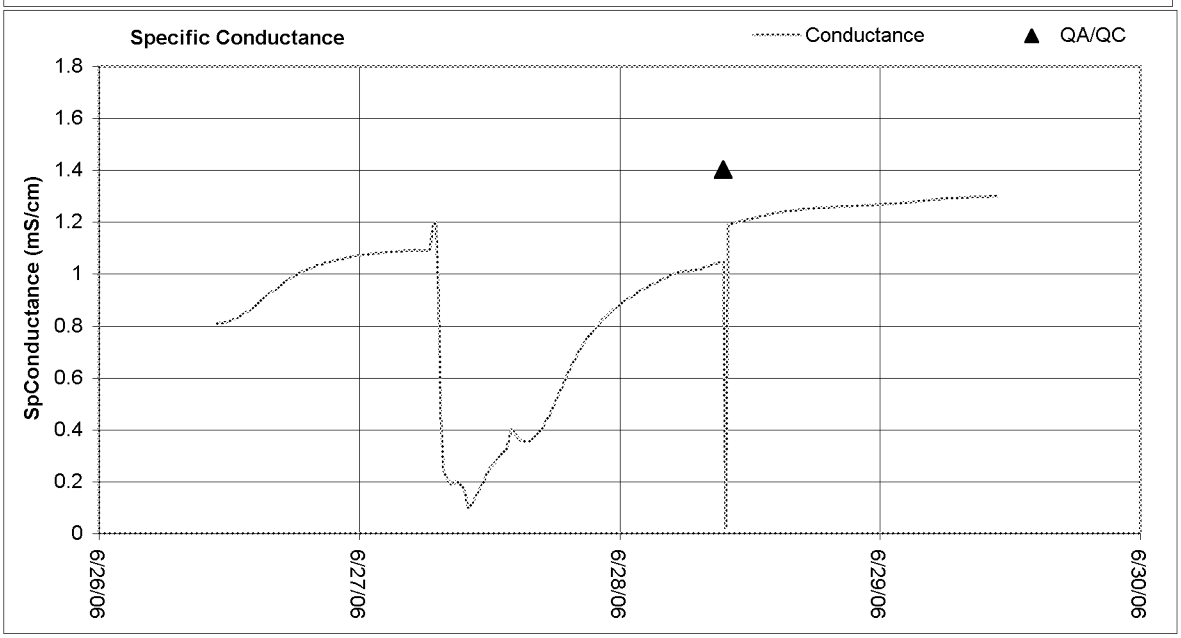




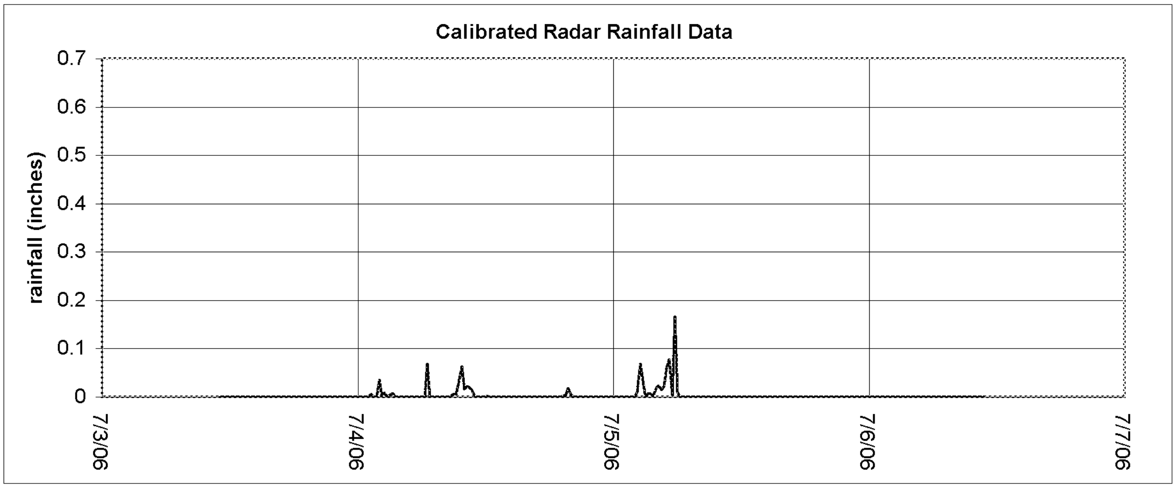
Nine Mile Run 1
(Probable CSO)

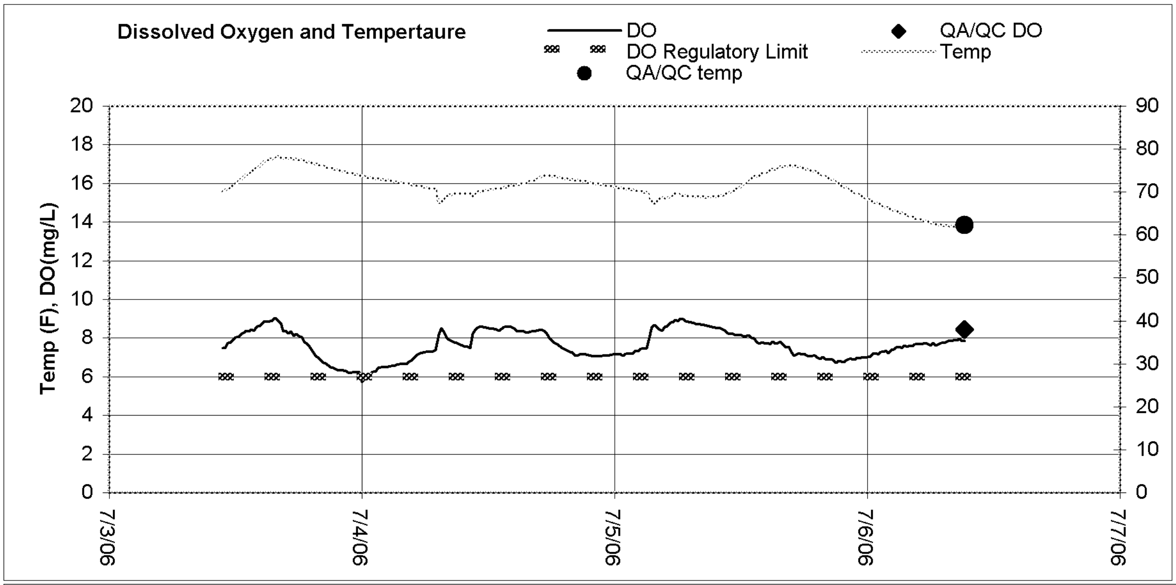


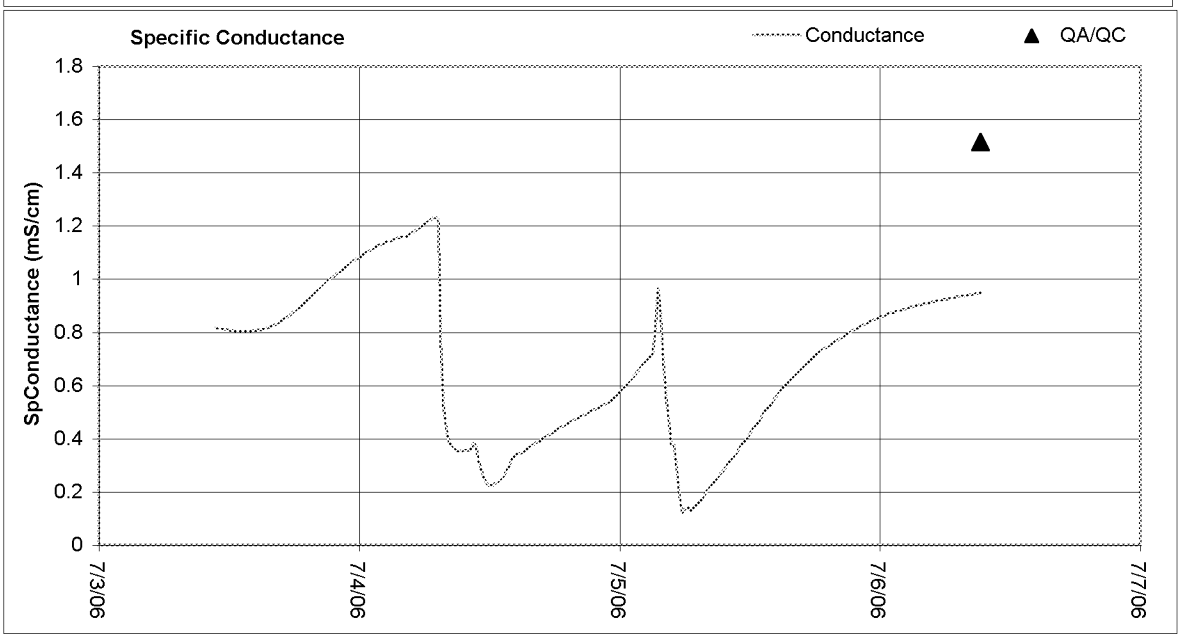




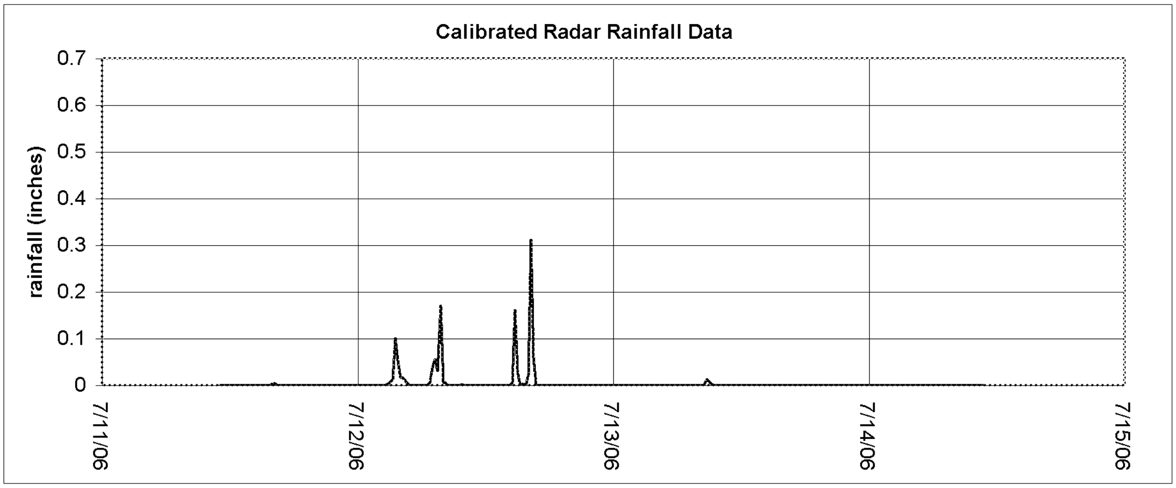
Nine Mile Run 1
(Probable CSO)

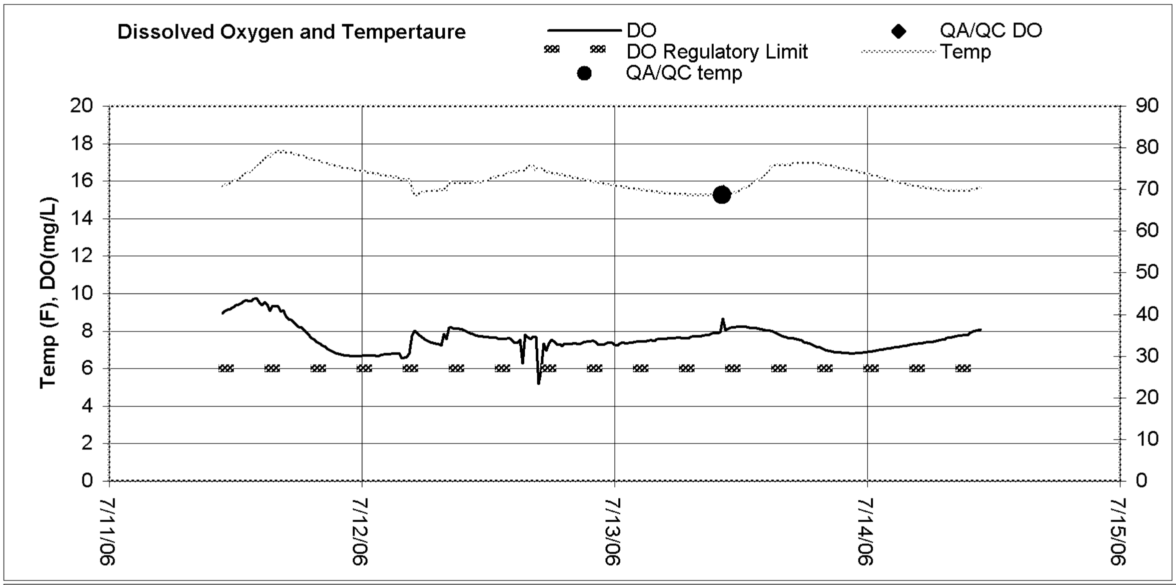


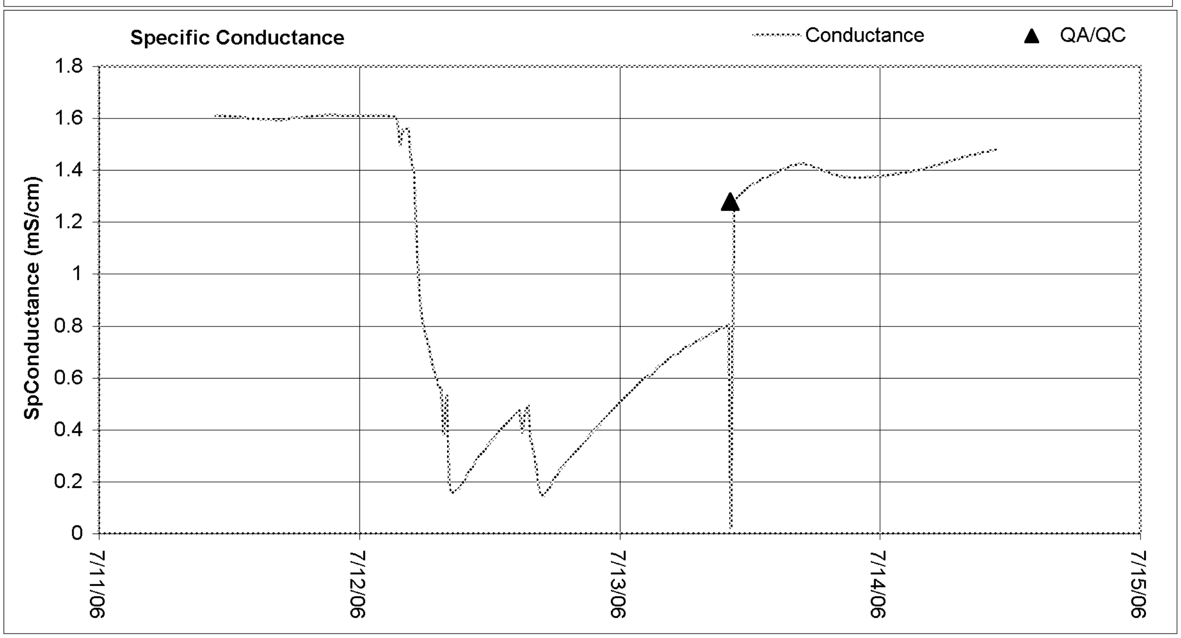




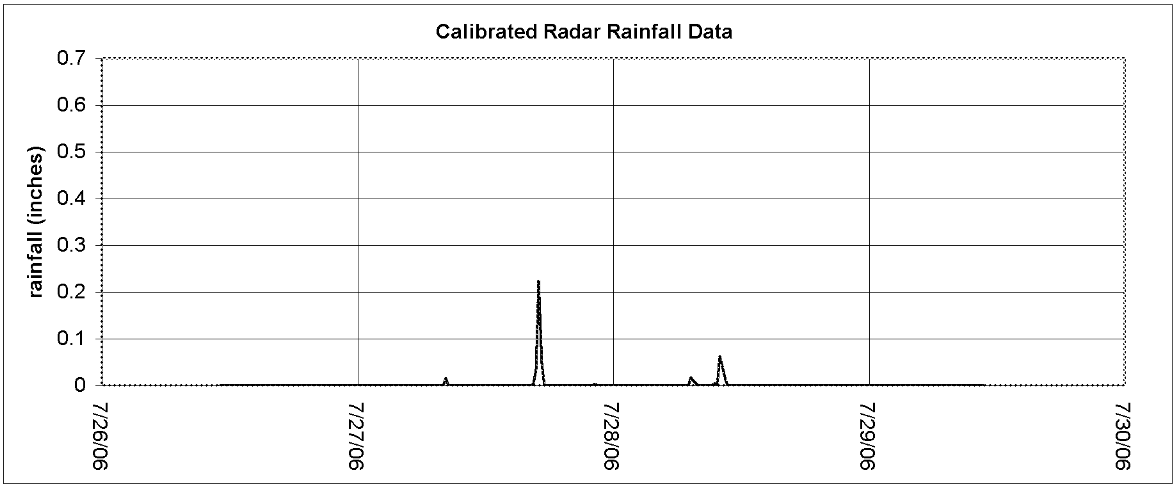
Nine Mile Run 1
(Probable CSO)

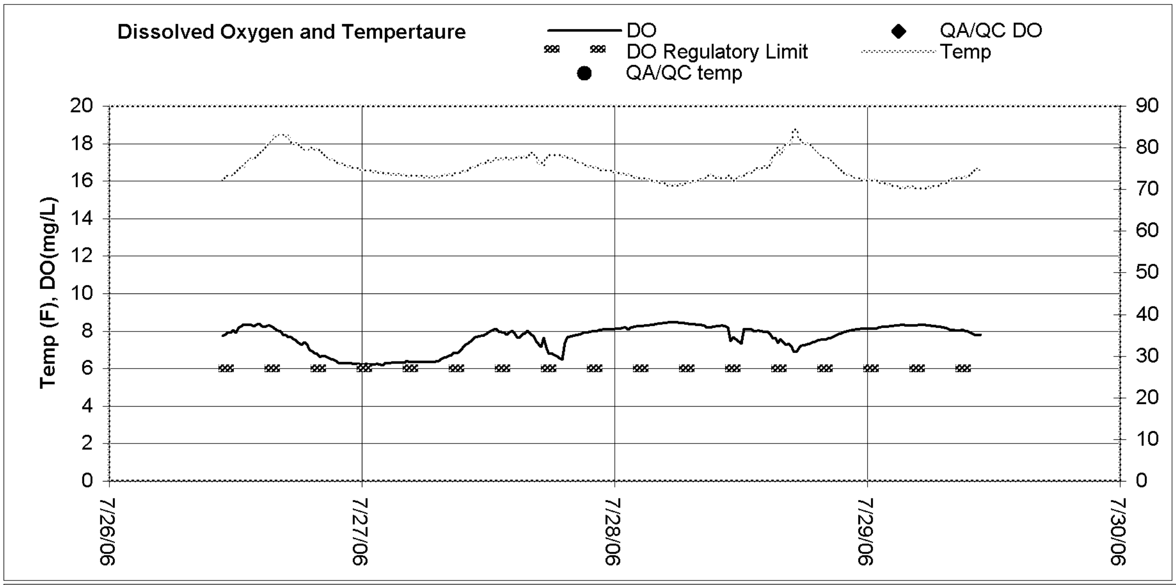


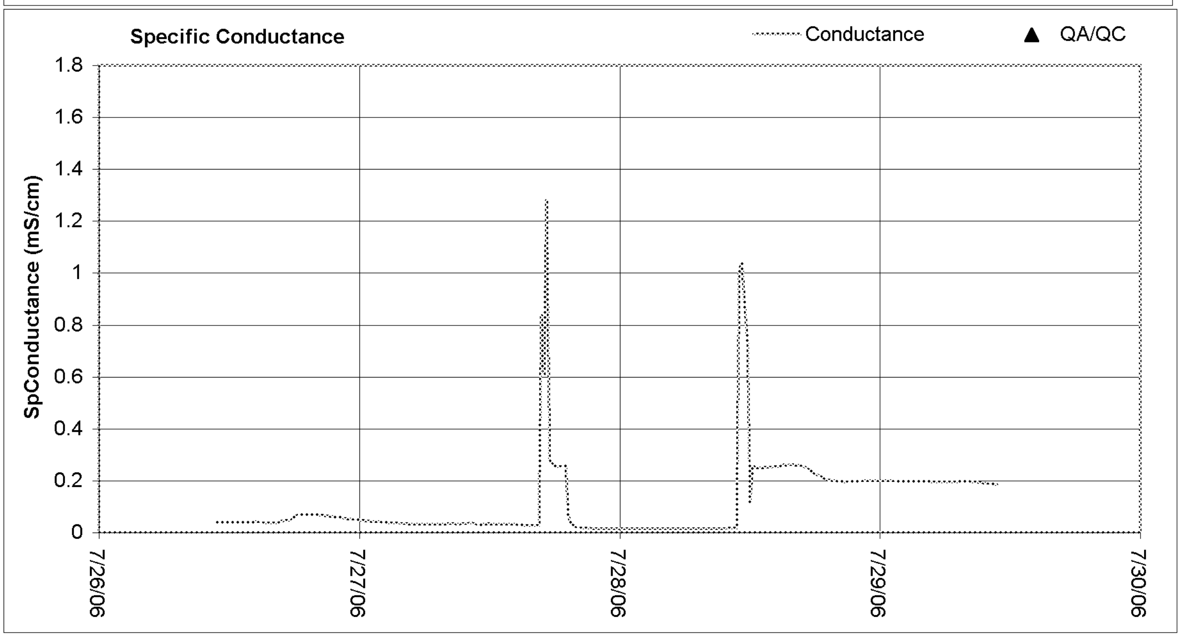




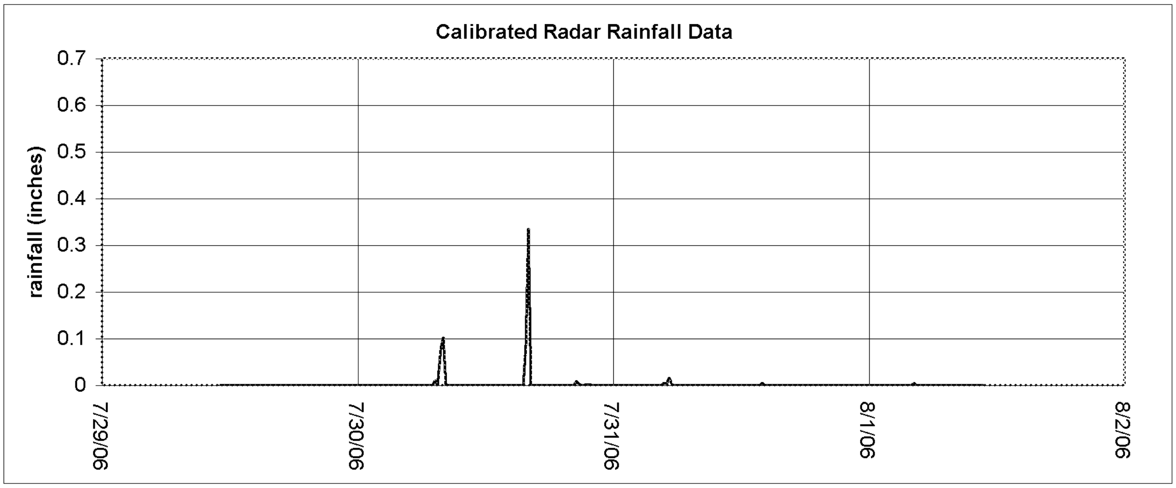
Nine Mile Run 1

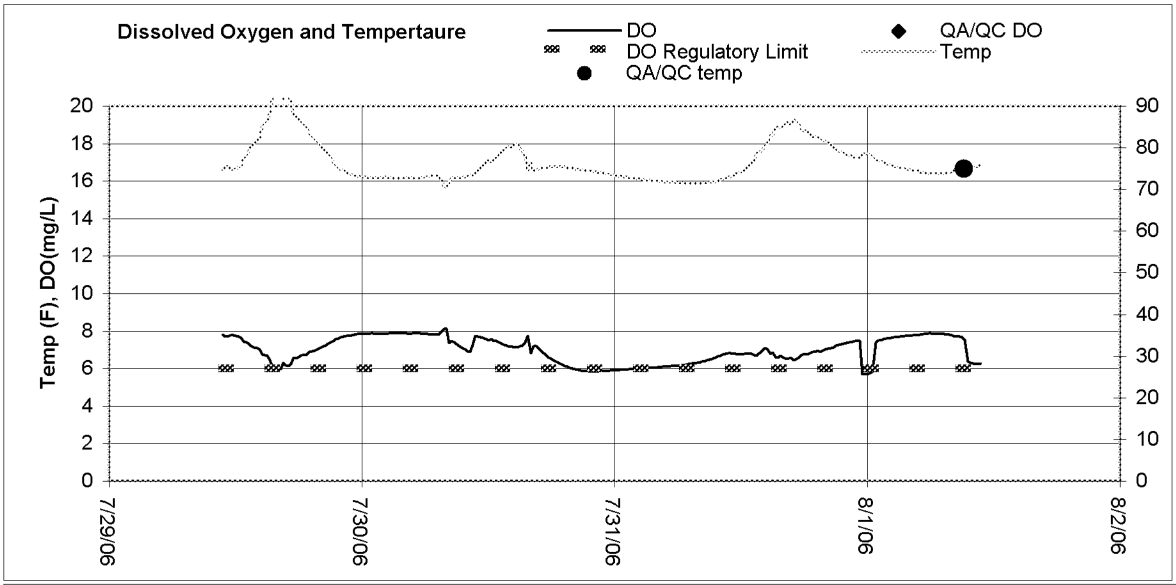


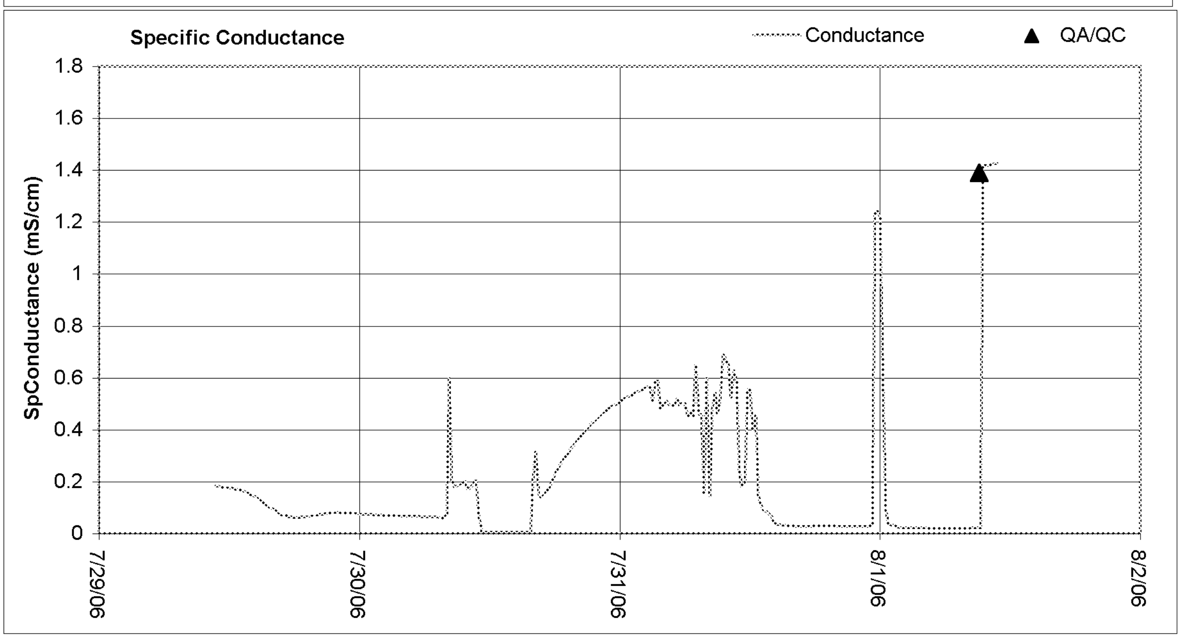




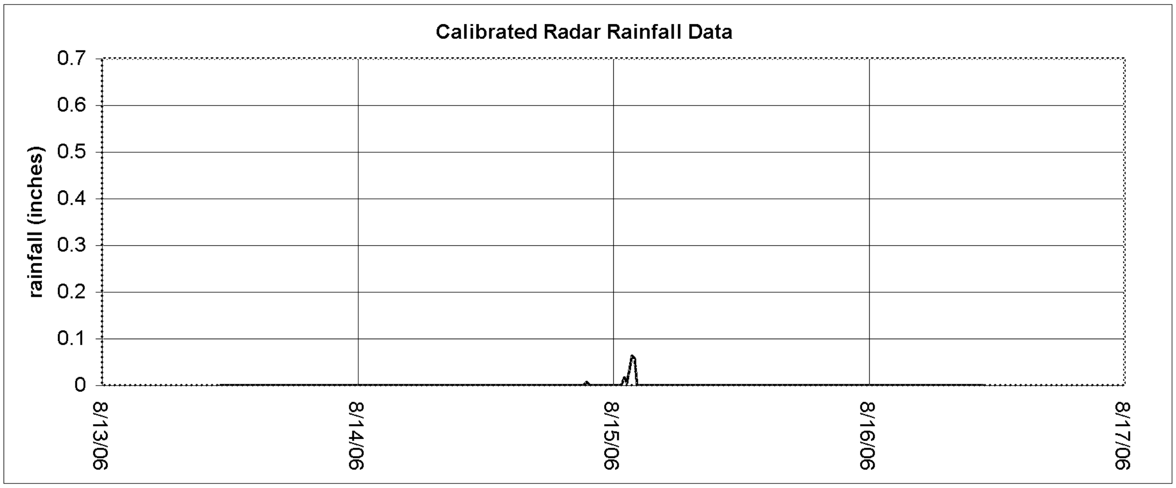
Nine Mile Run 1

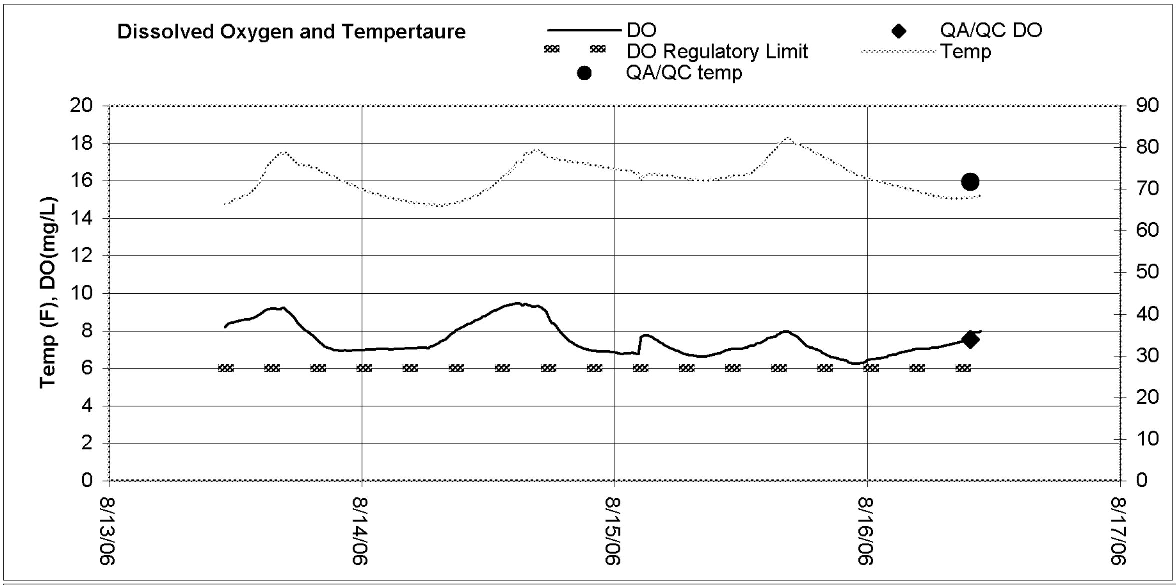


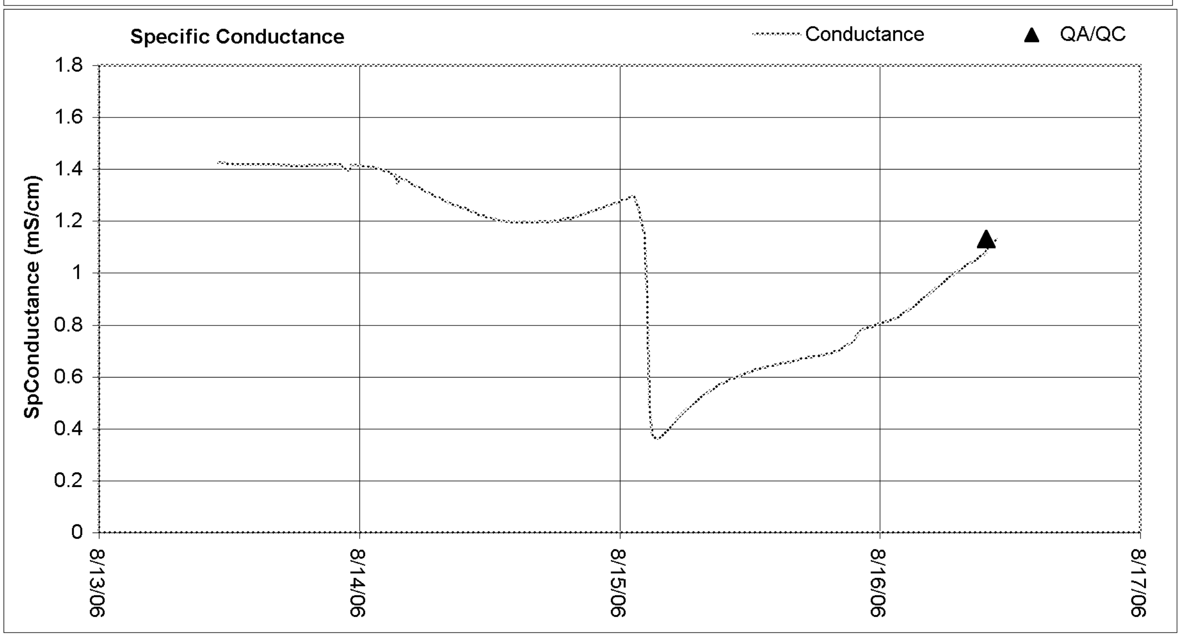




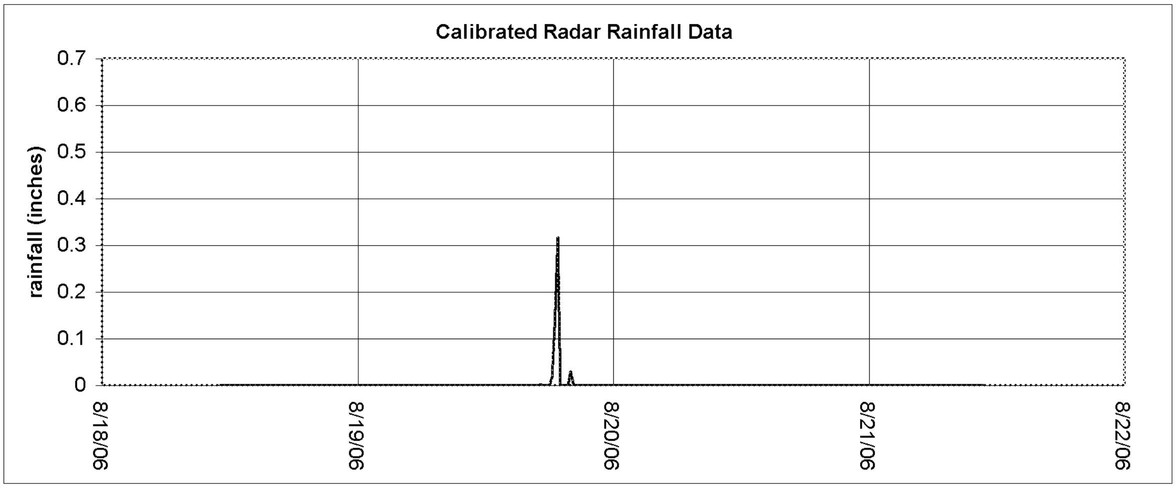
Nine Mile Run 1

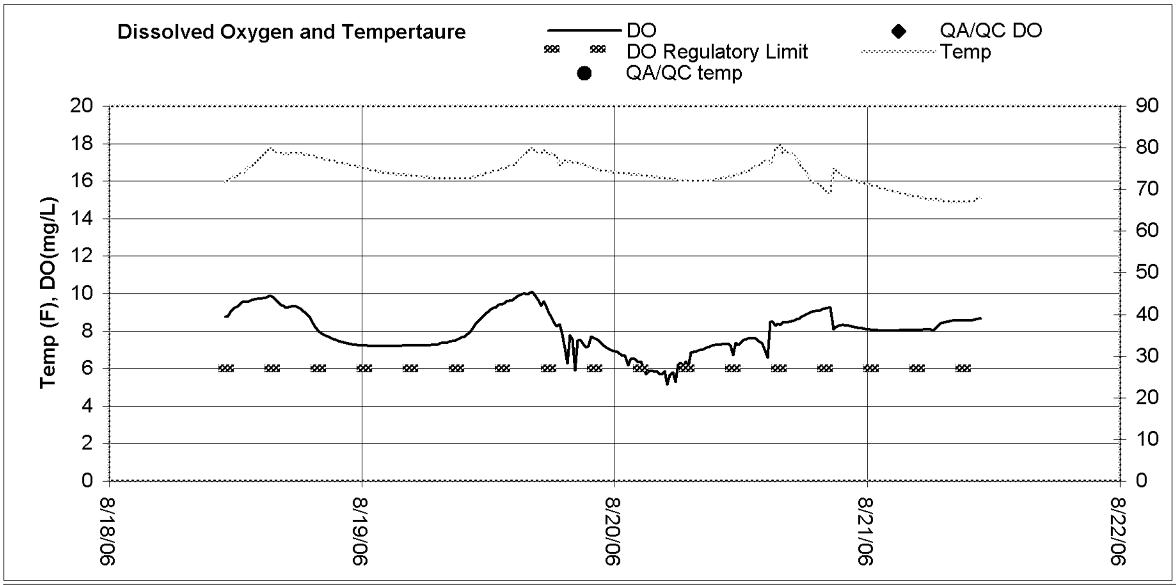


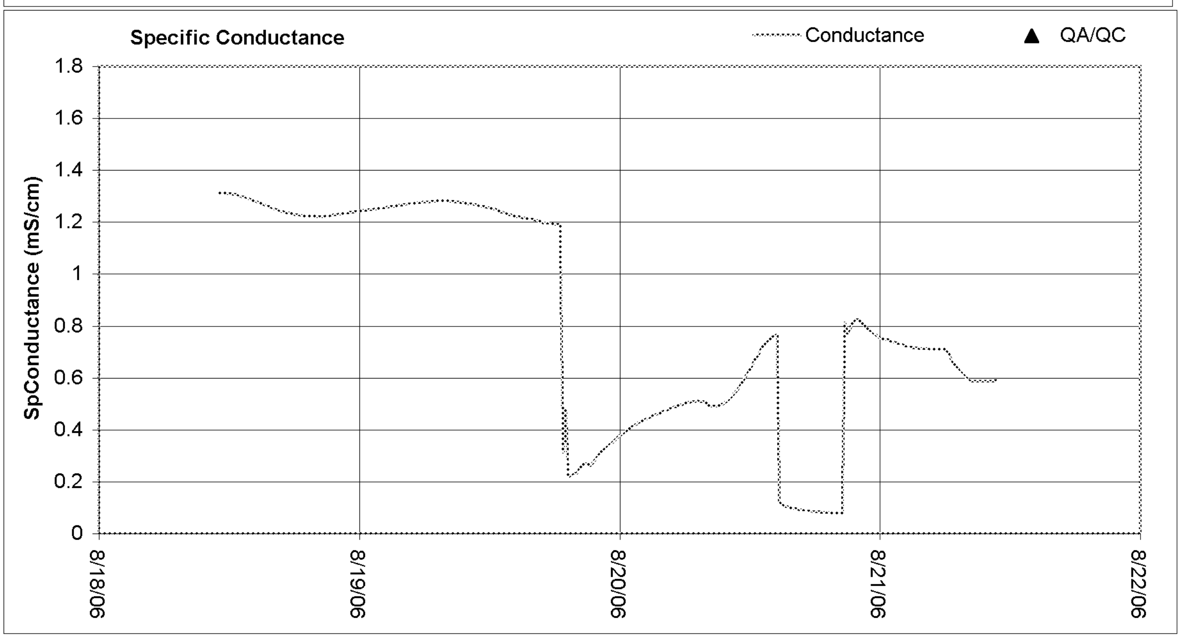




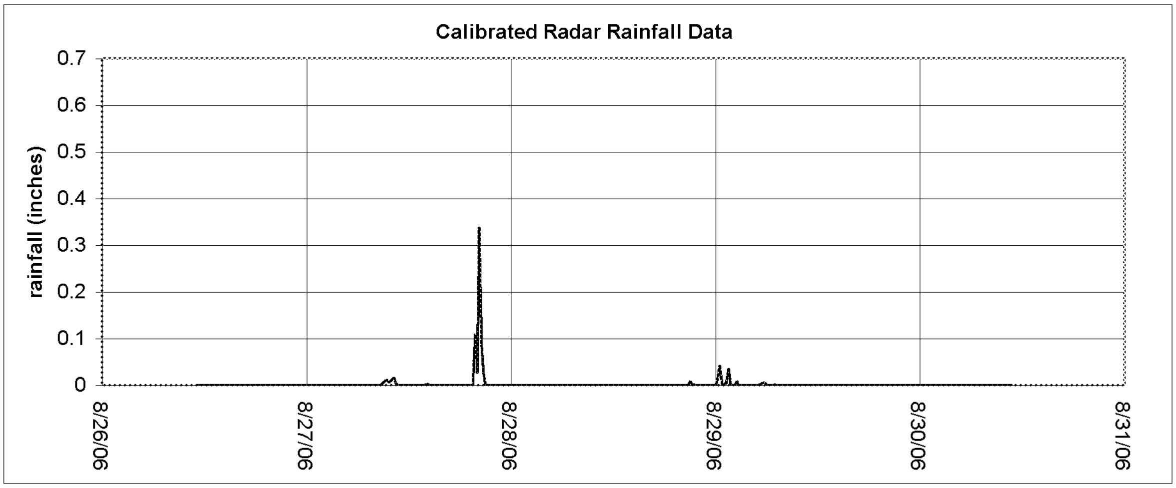
Nine Mile Run 1

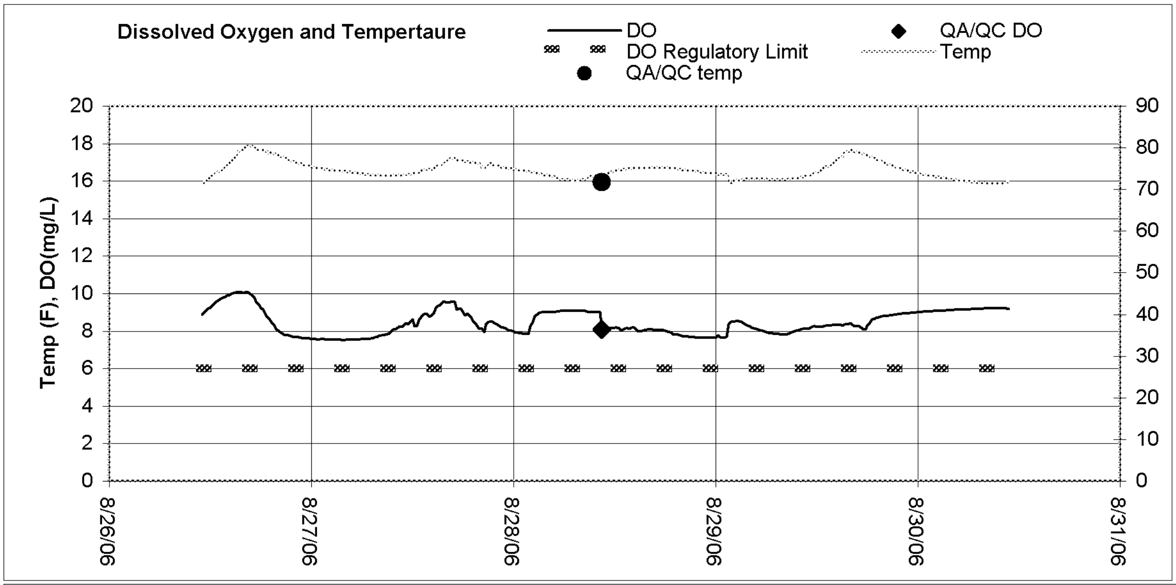


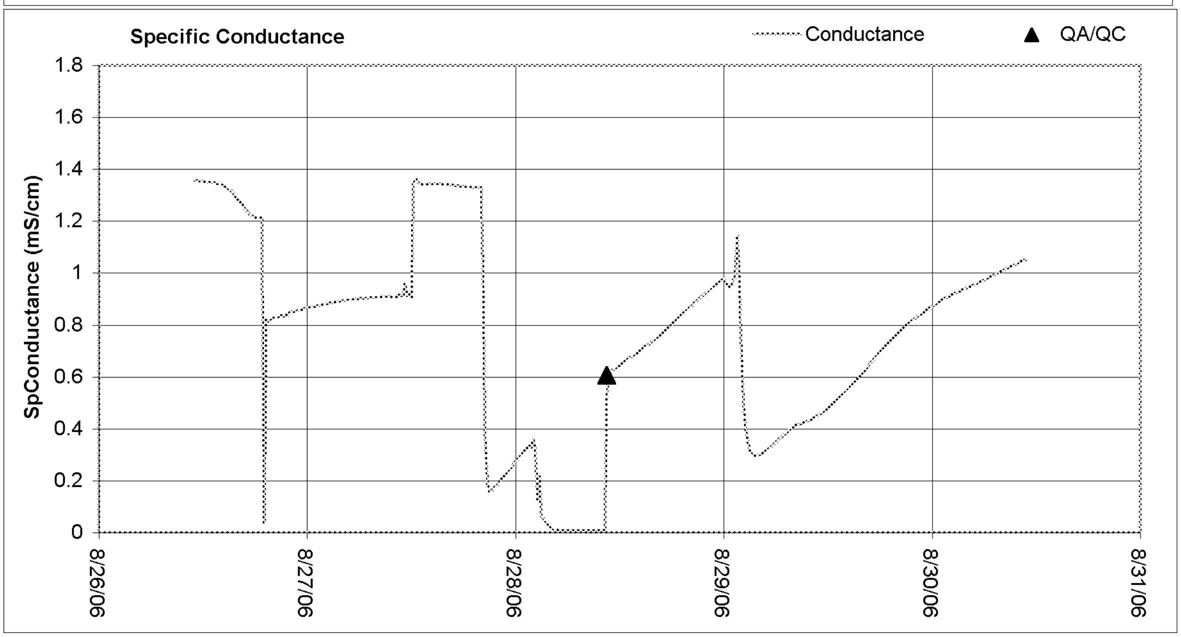




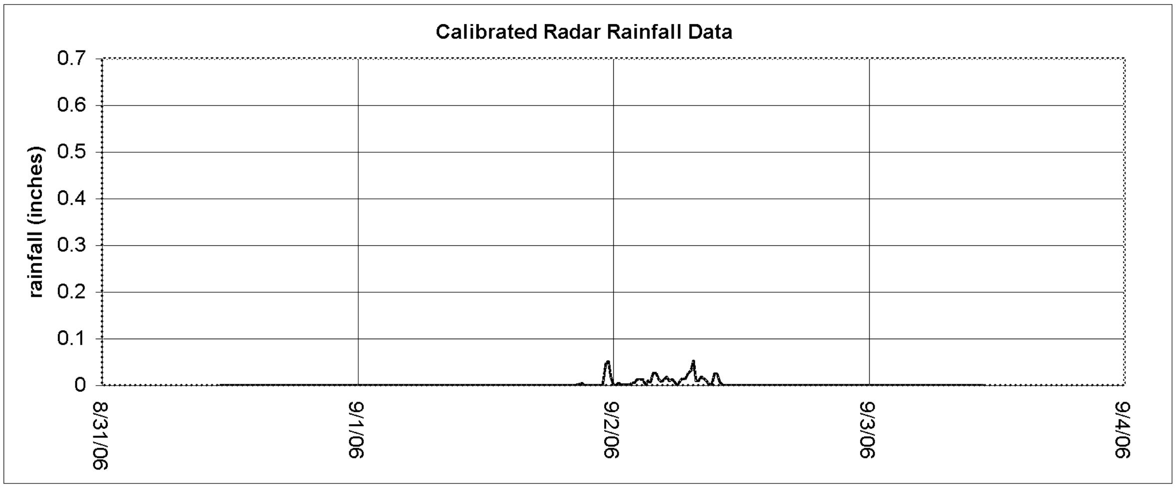
Nine Mile Run 1
(Probable CSO)

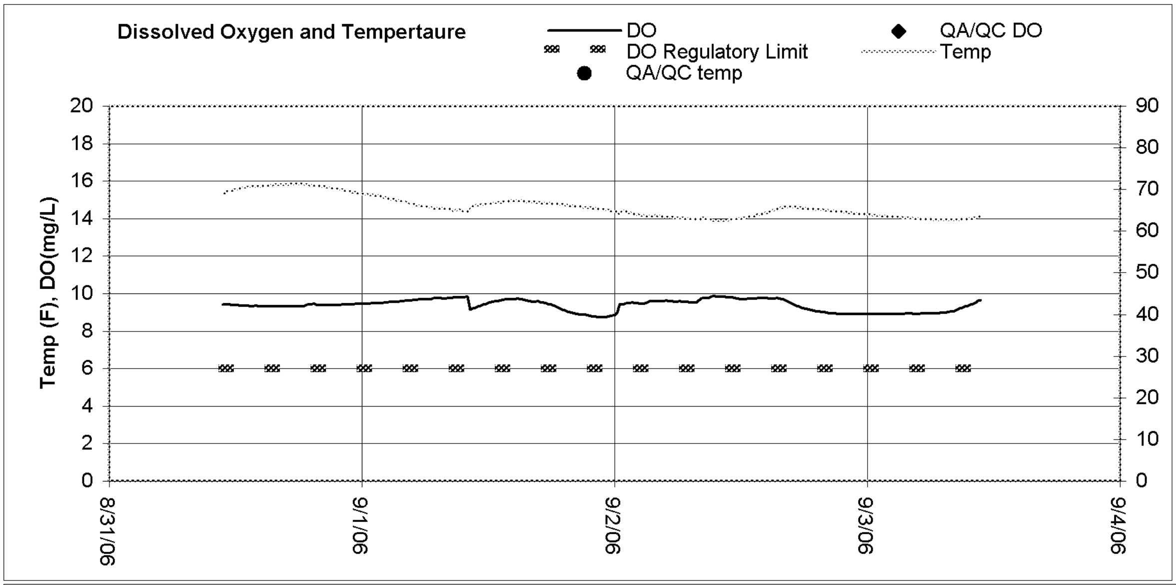


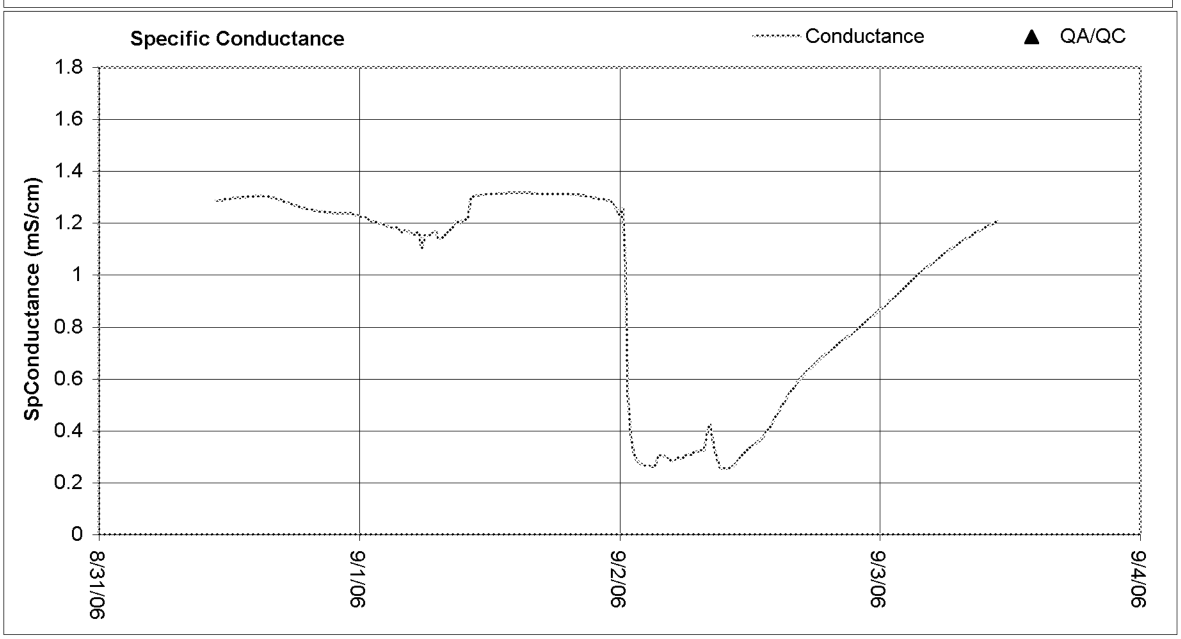




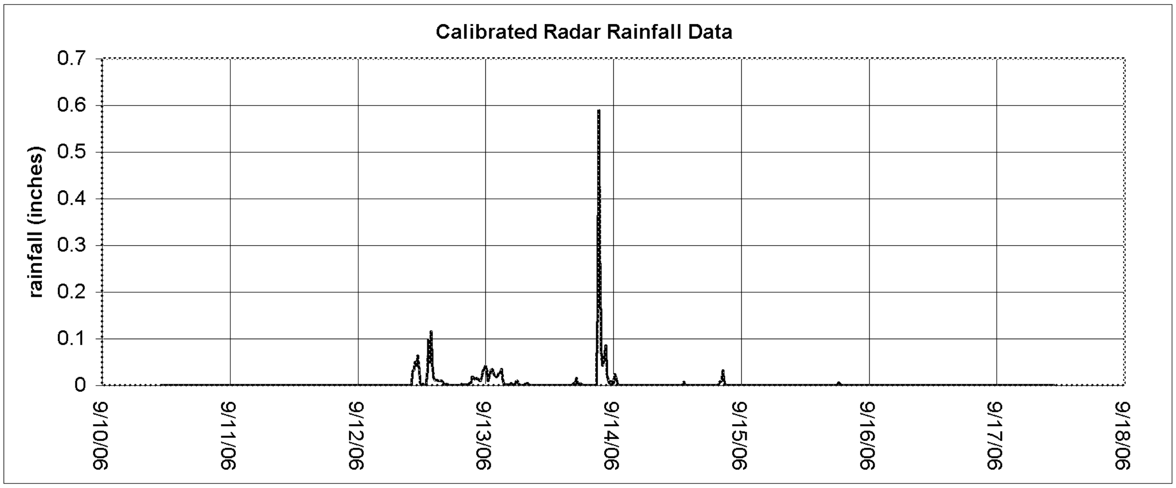
Nine Mile Run 1
(Probable CSO)

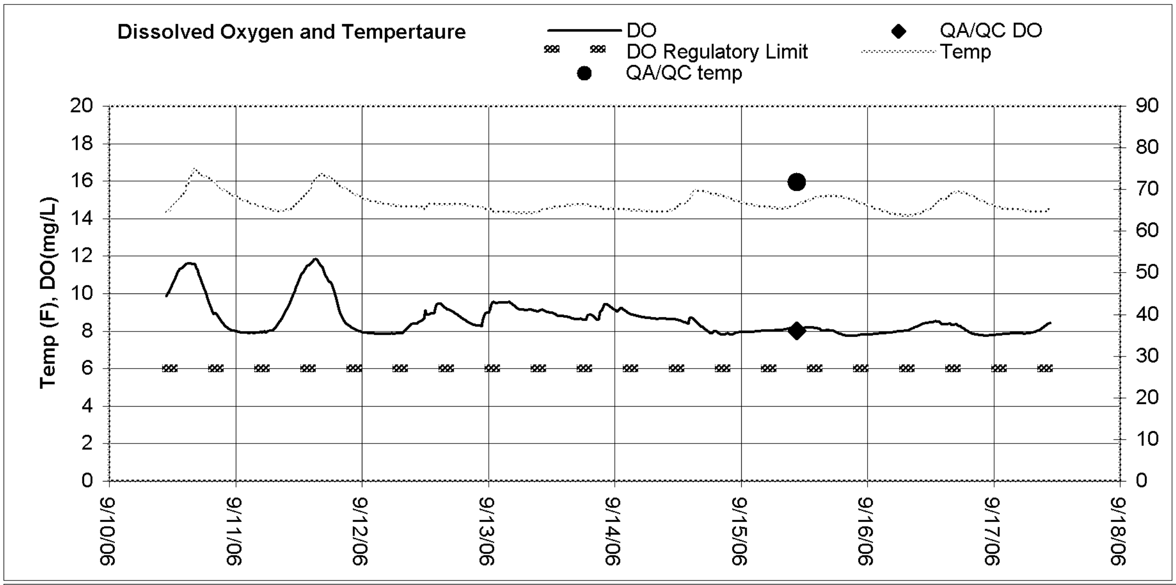


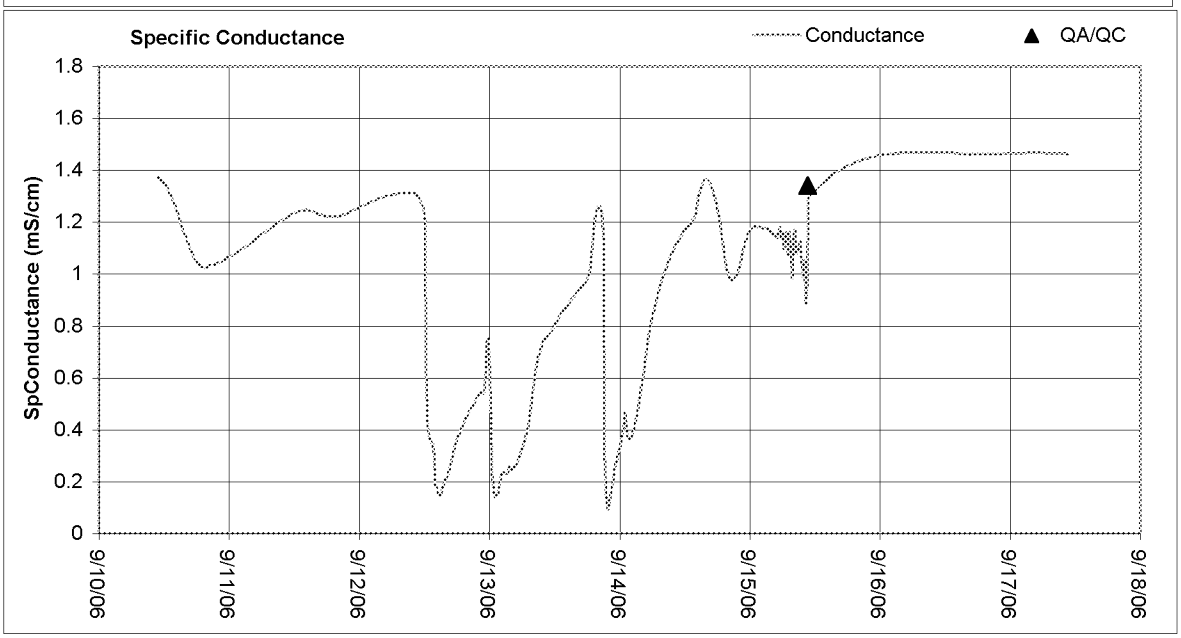




Nine Mile Run 1
(Probable CSO)

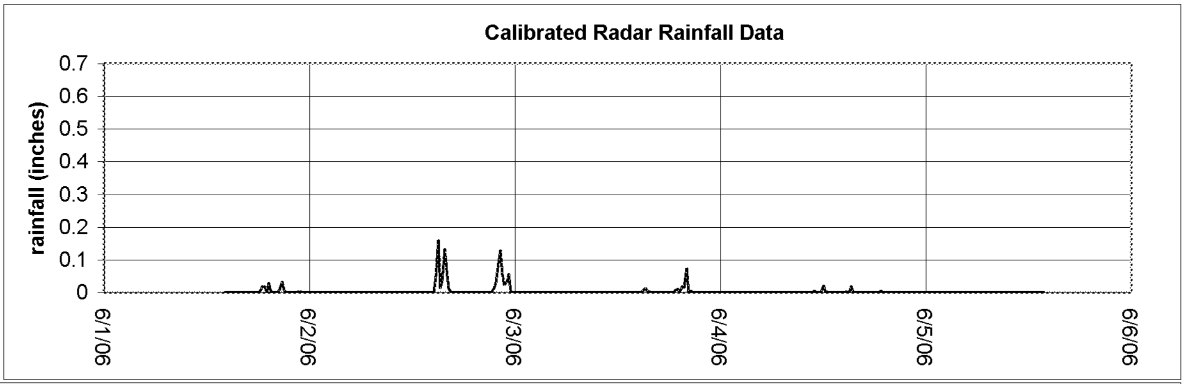


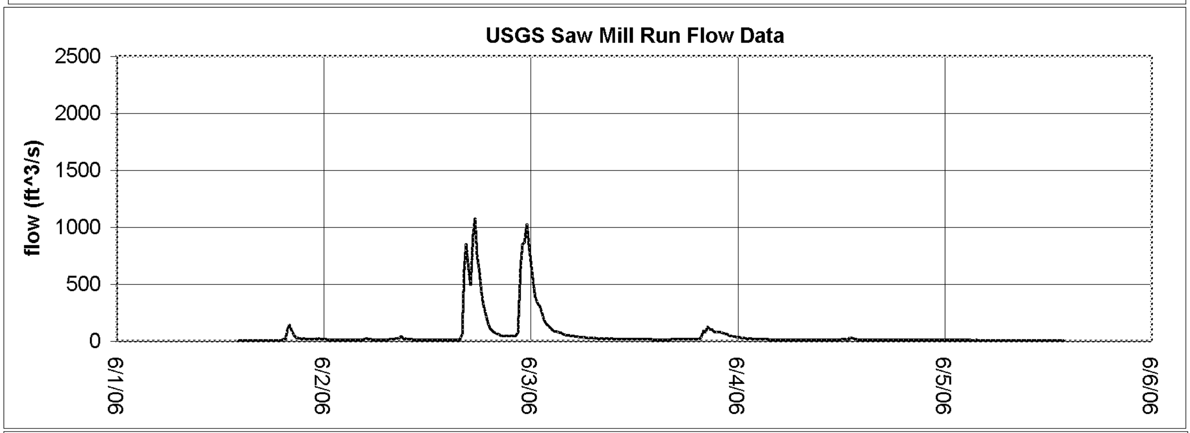


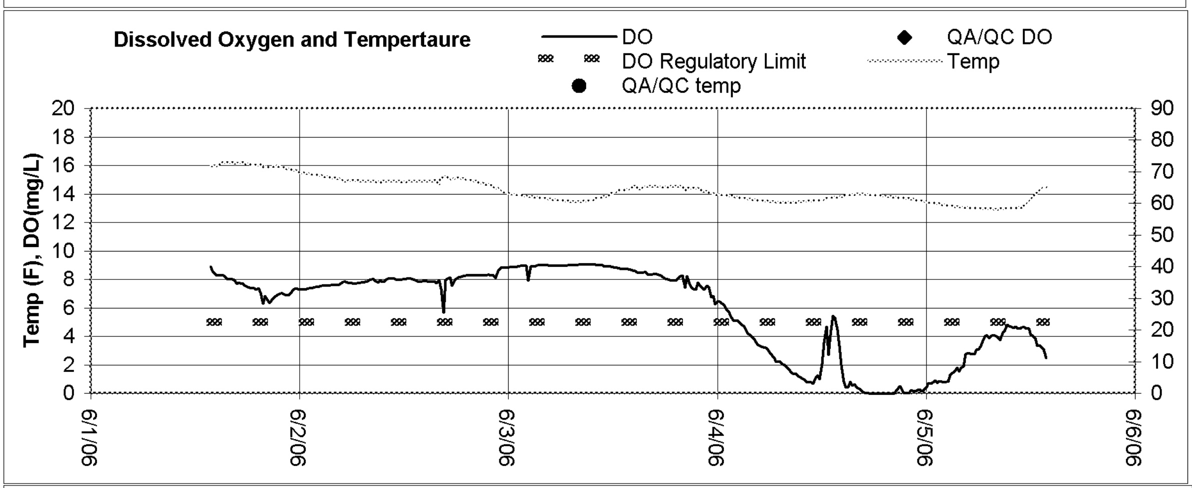


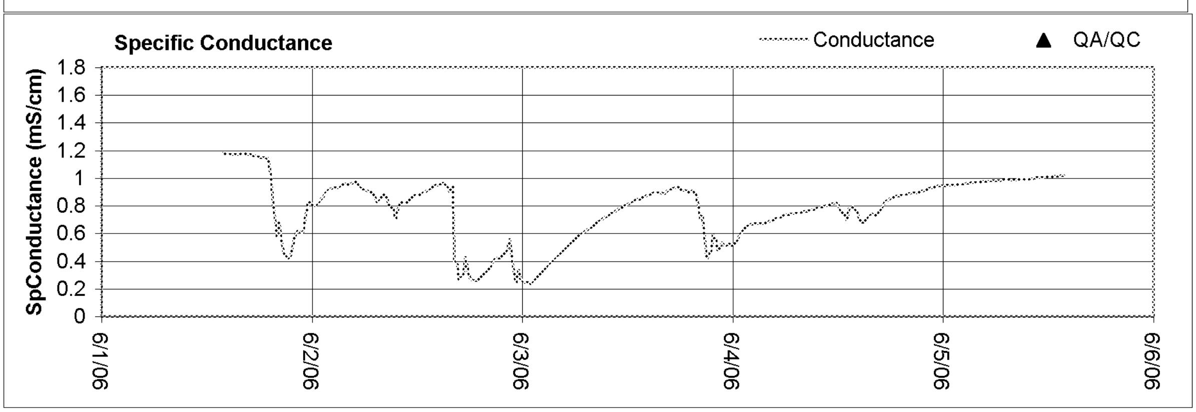
SAW MILL RUN (SM-SW-1)
WET WETHER DATA GRAPHS

Saw Mill Run 1
(Probable CSO)

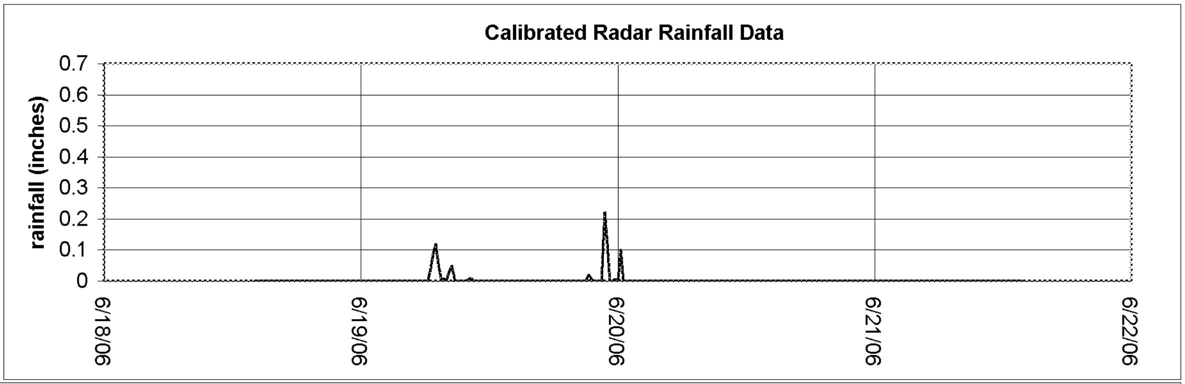


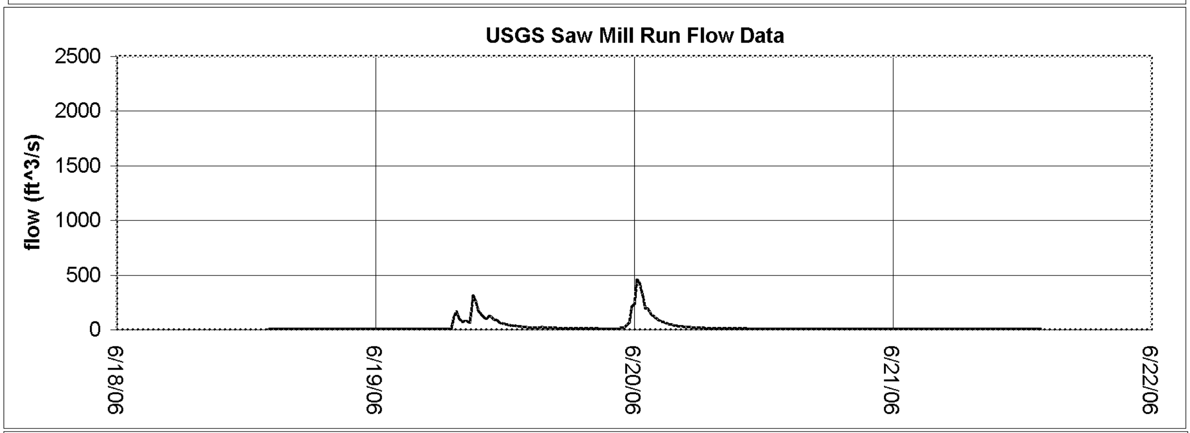


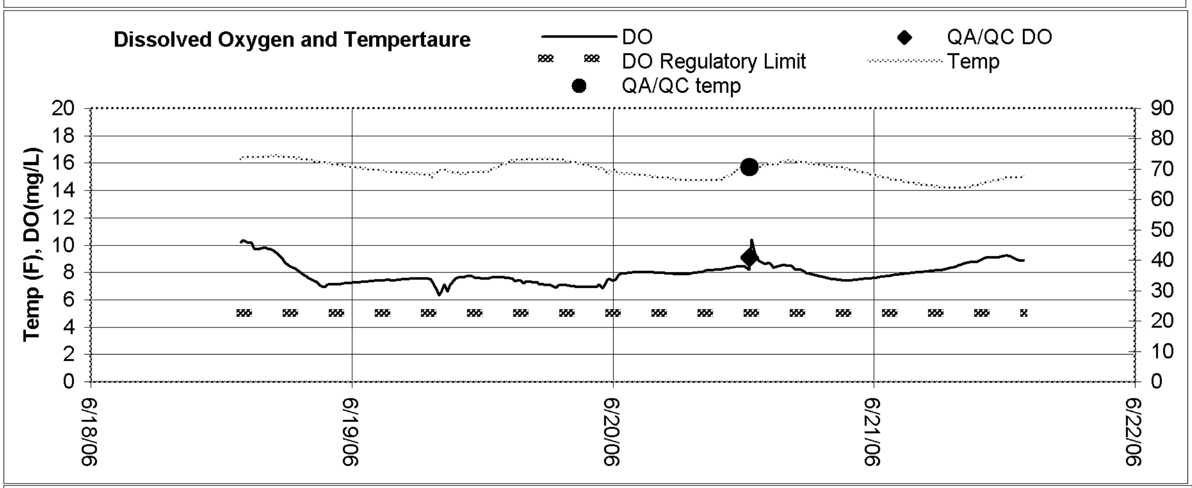


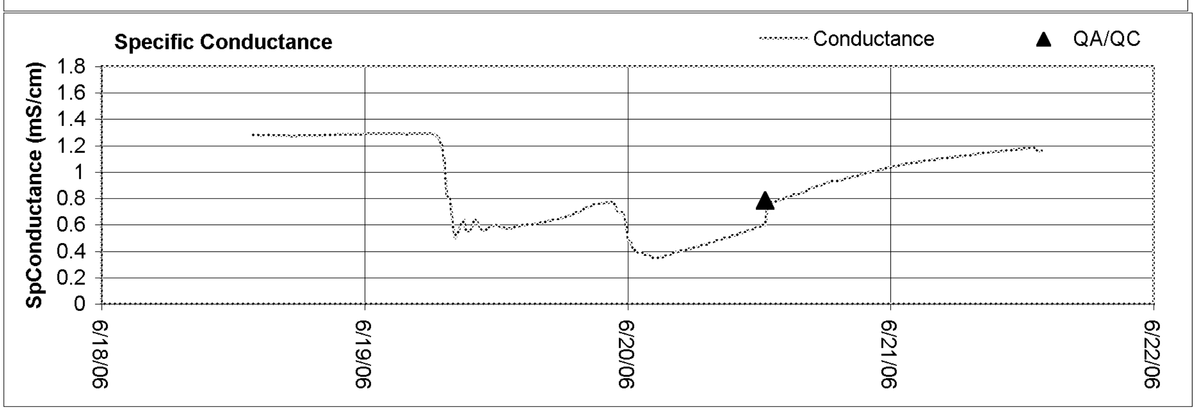


Saw Mill Run 1
(Probable CSO)

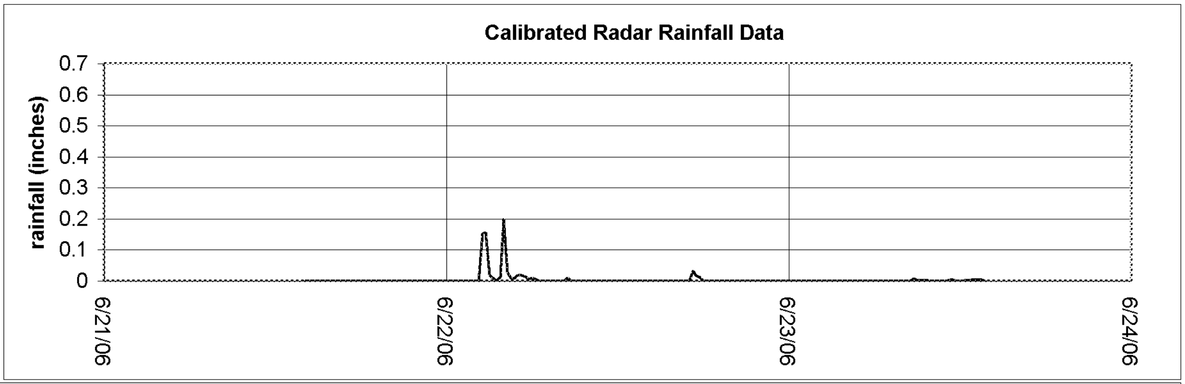


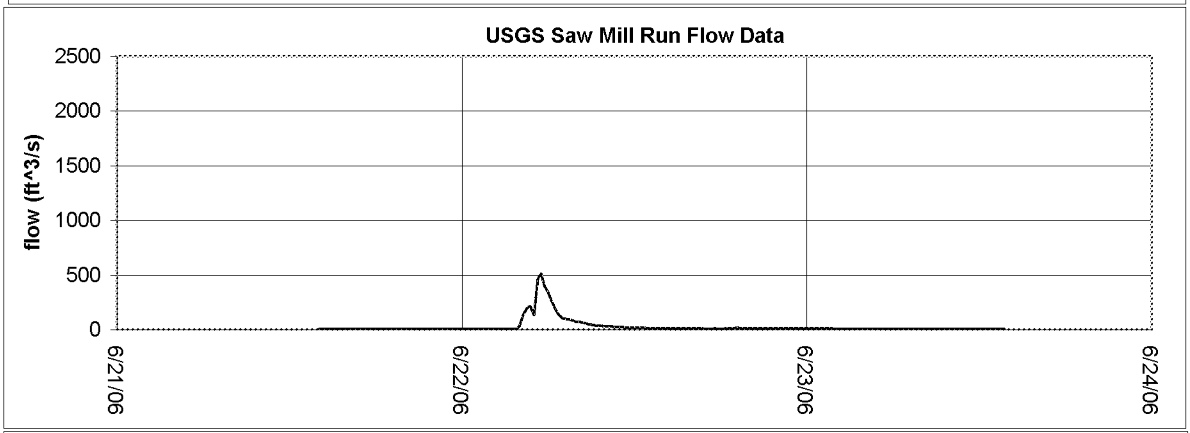


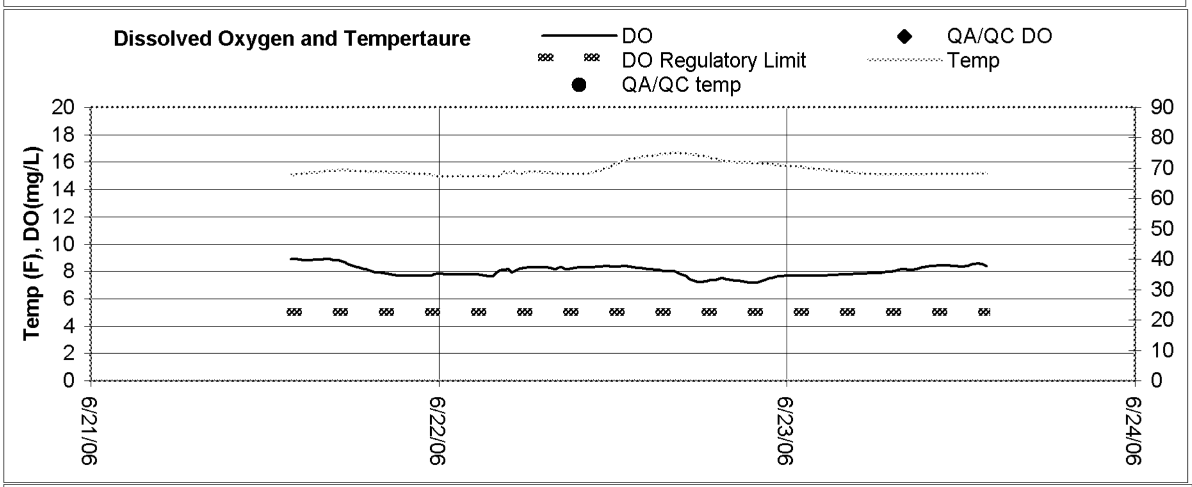


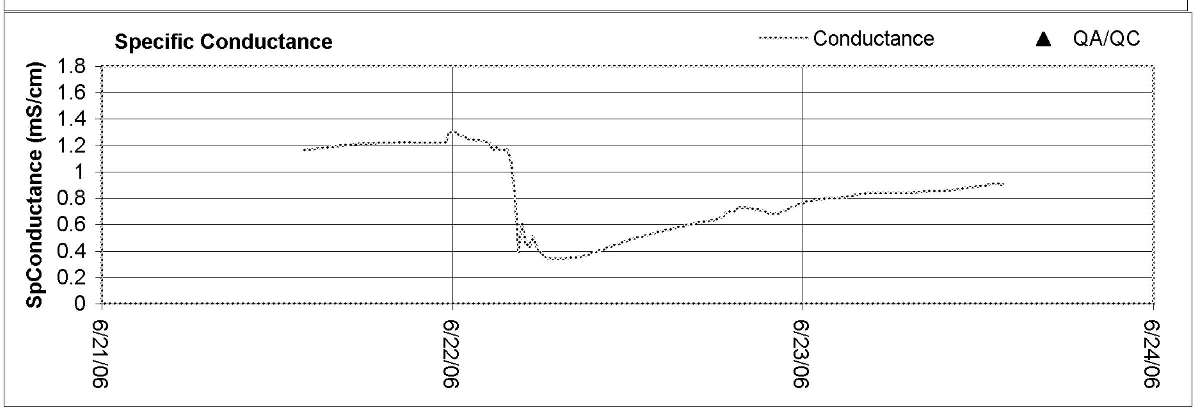


Saw Mill Run 1
(Probable CSO)

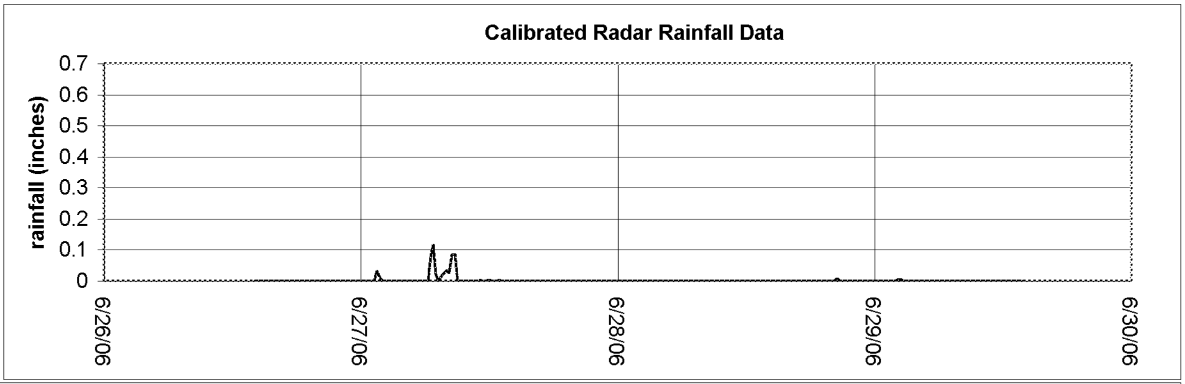


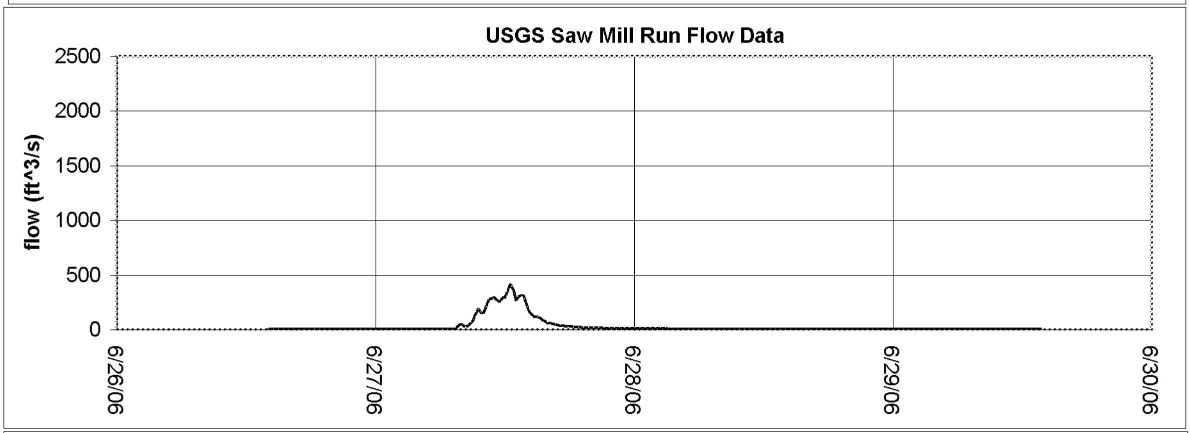


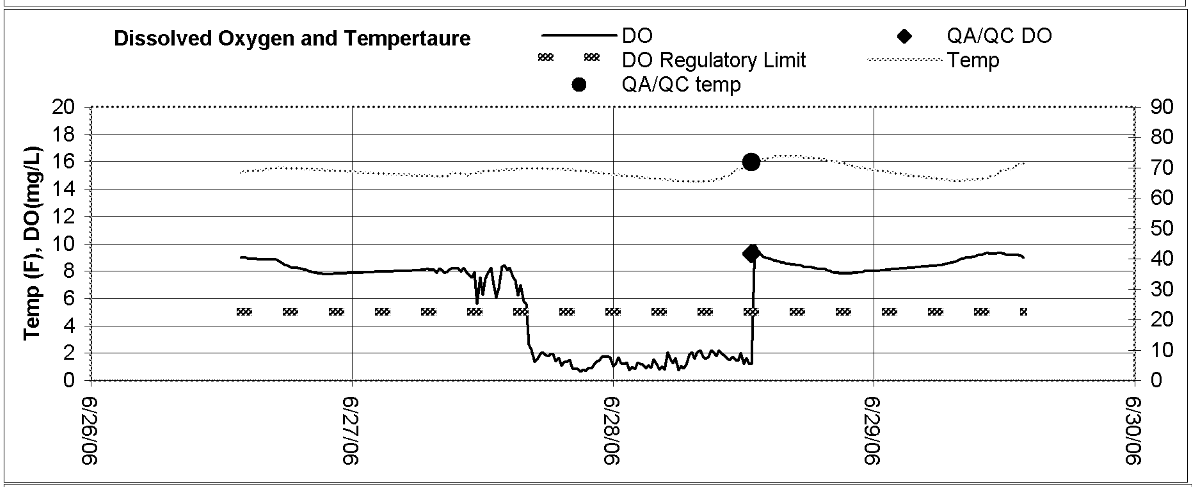


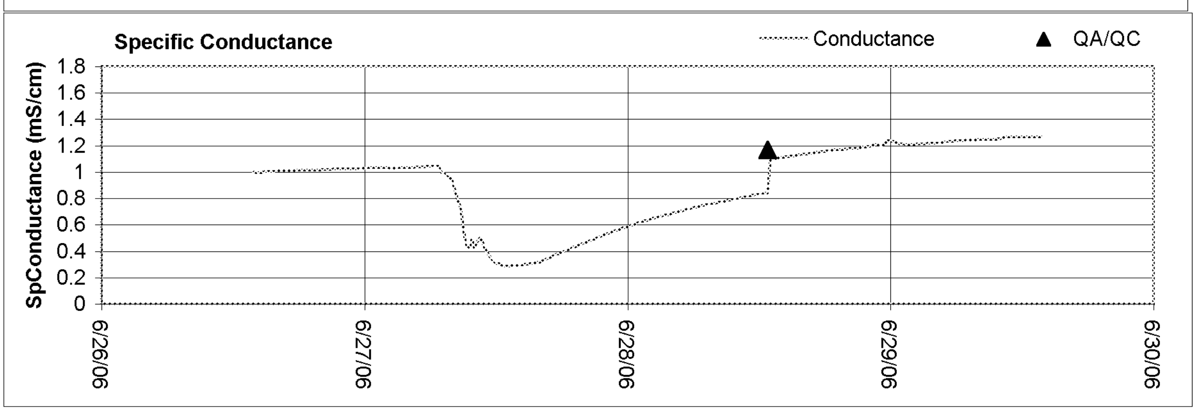


Saw Mill Run 1
(Probable CSO)

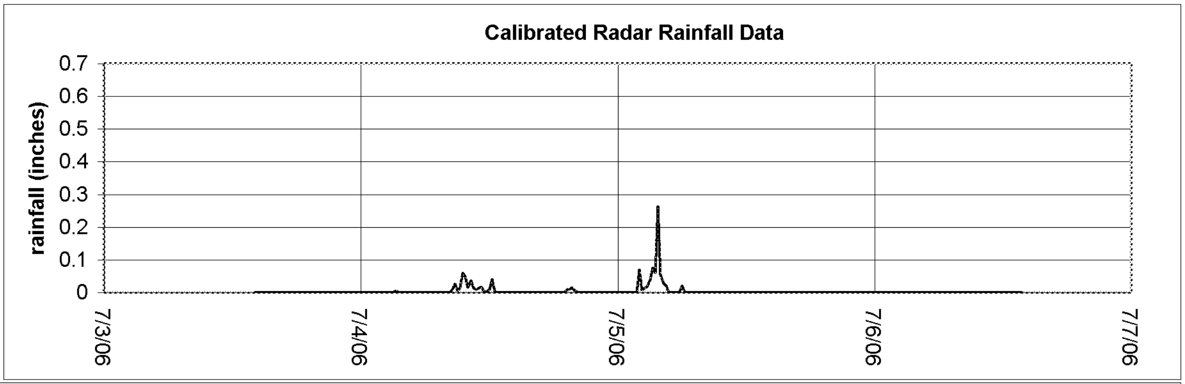


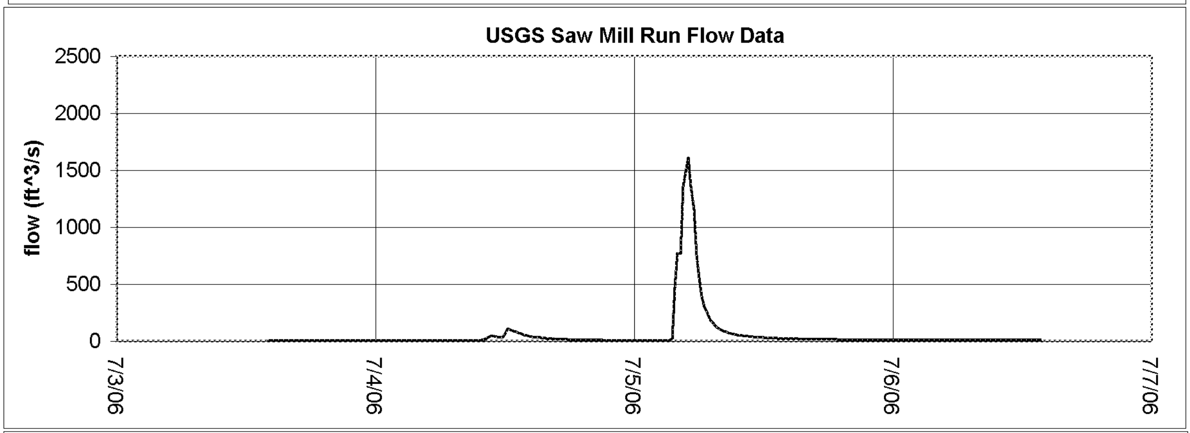


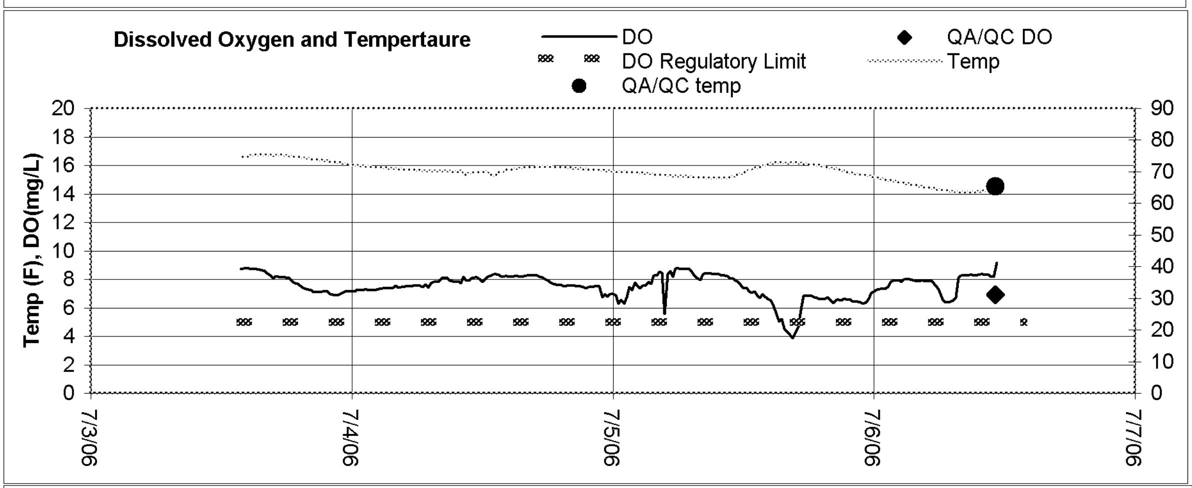


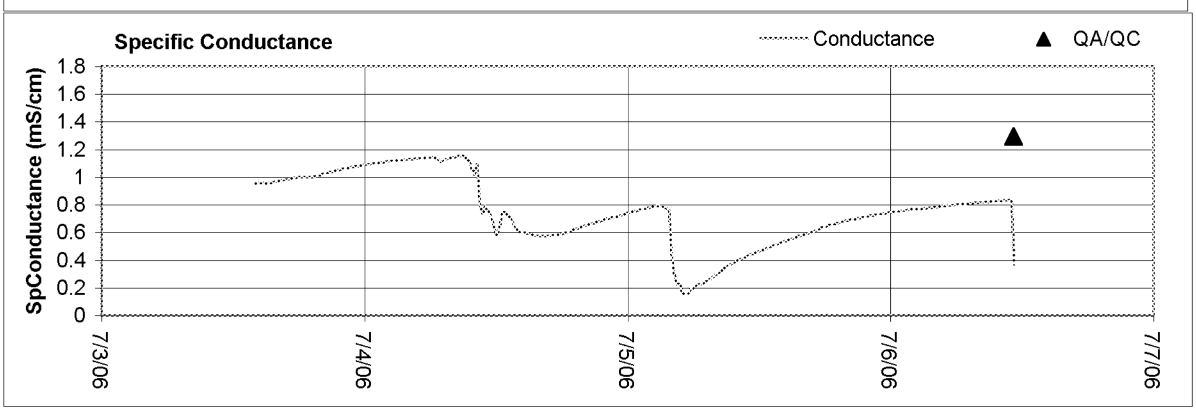


Saw Mill Run 1
(Probable CSO)



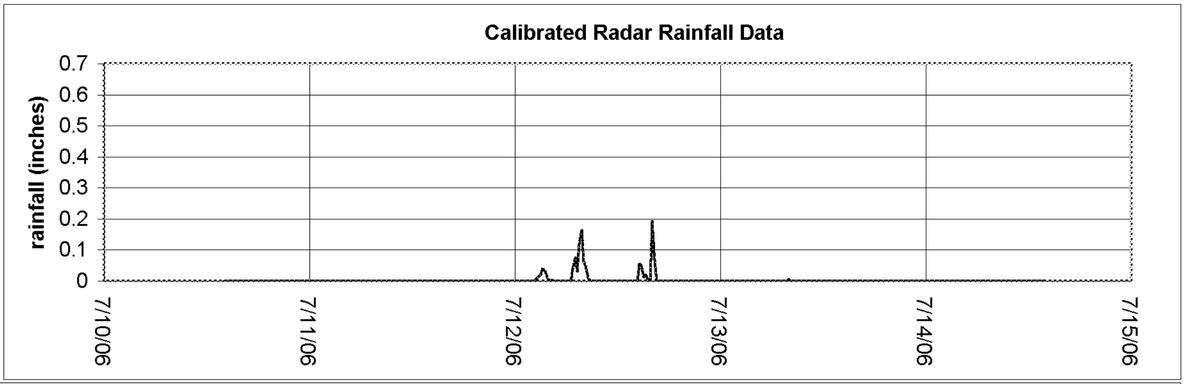


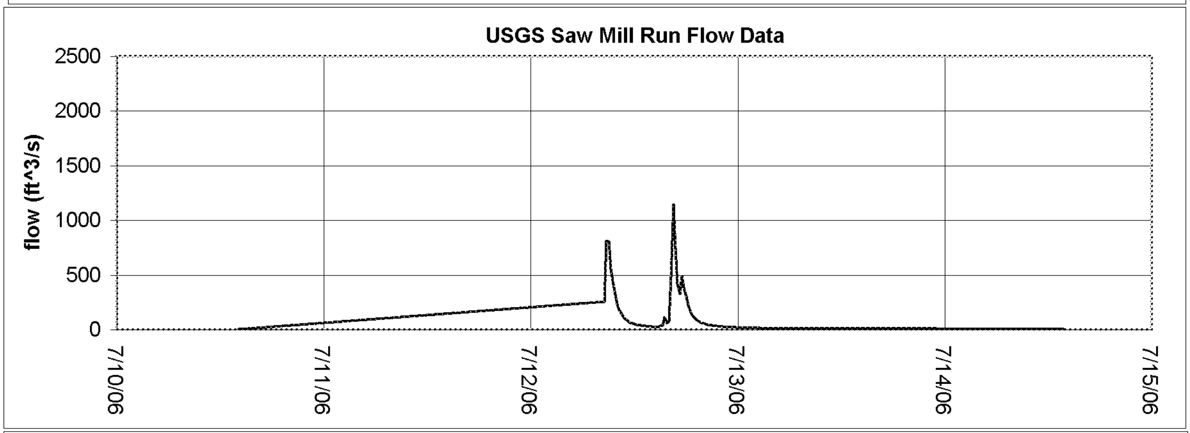


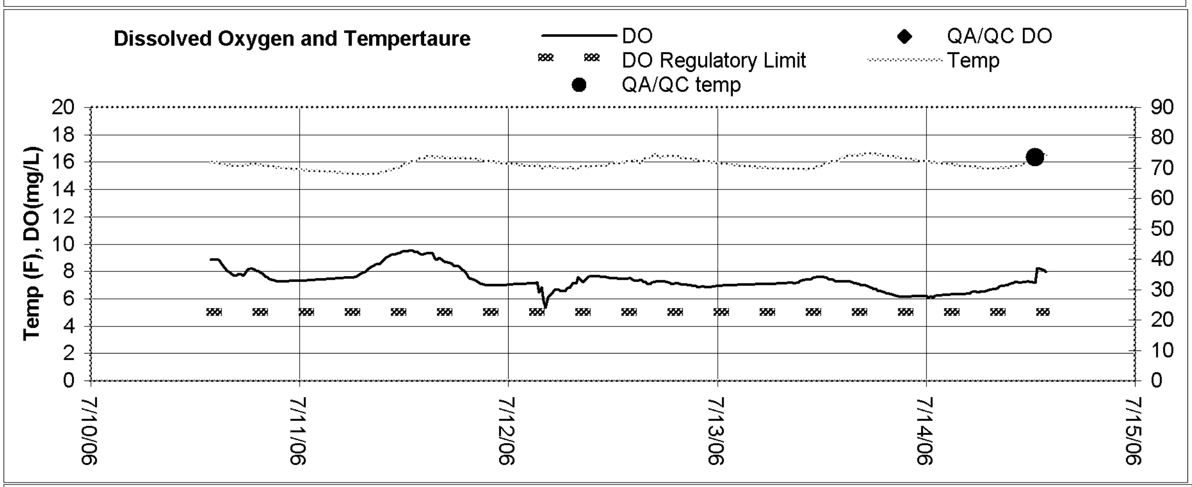


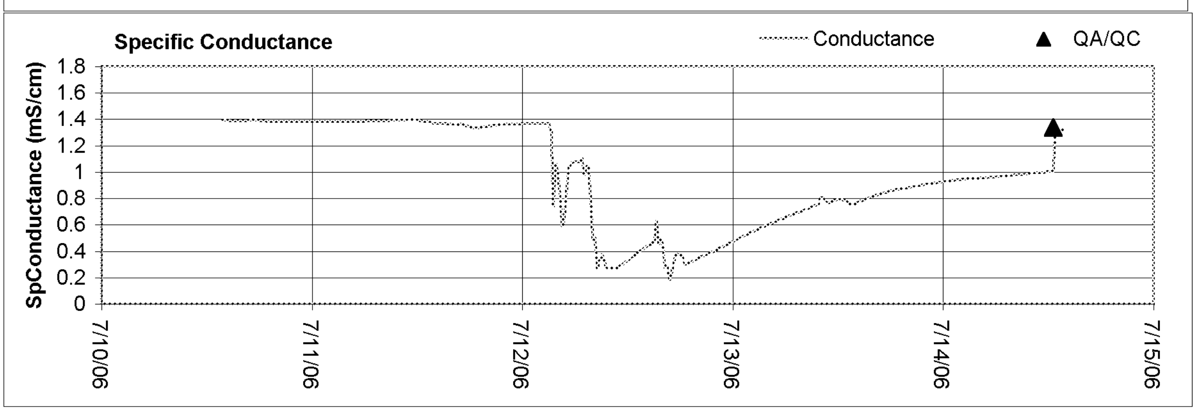
ATTACHMENT C - APPENDIX B

Saw Mill Run 1
(Probable CSO)



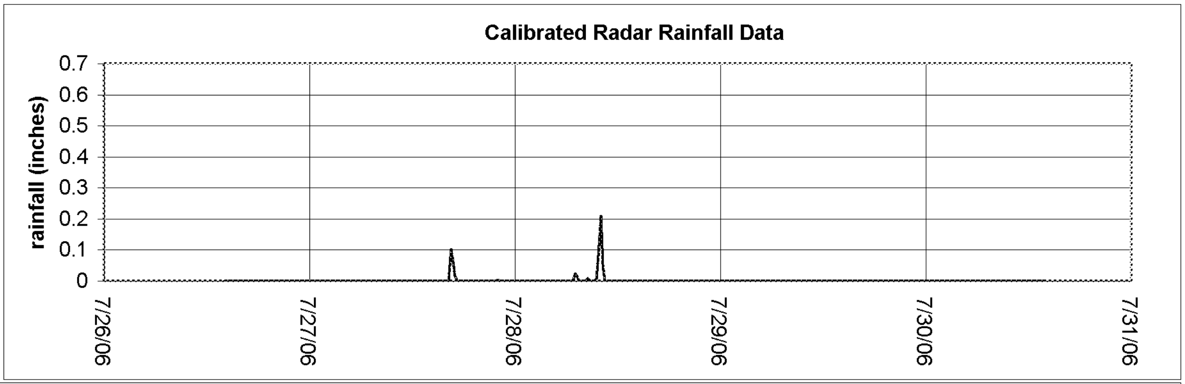


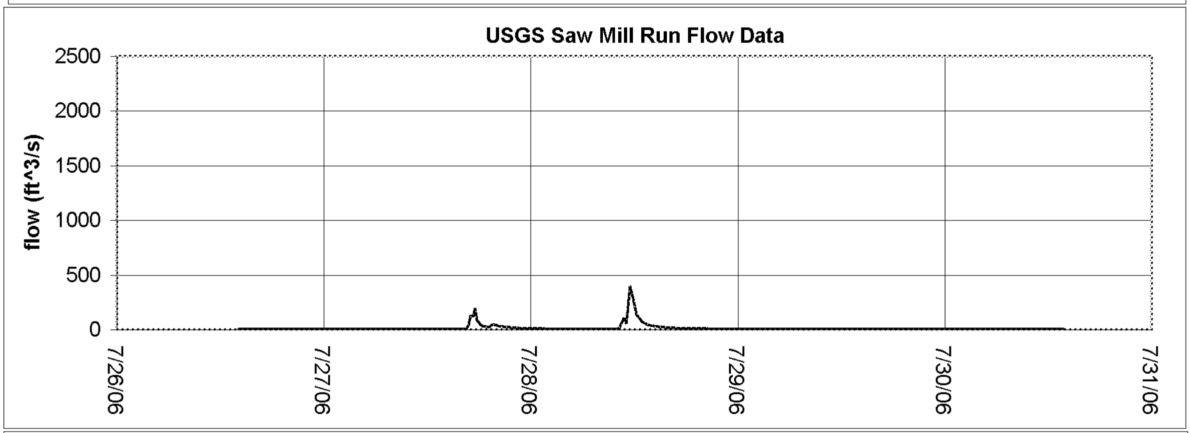


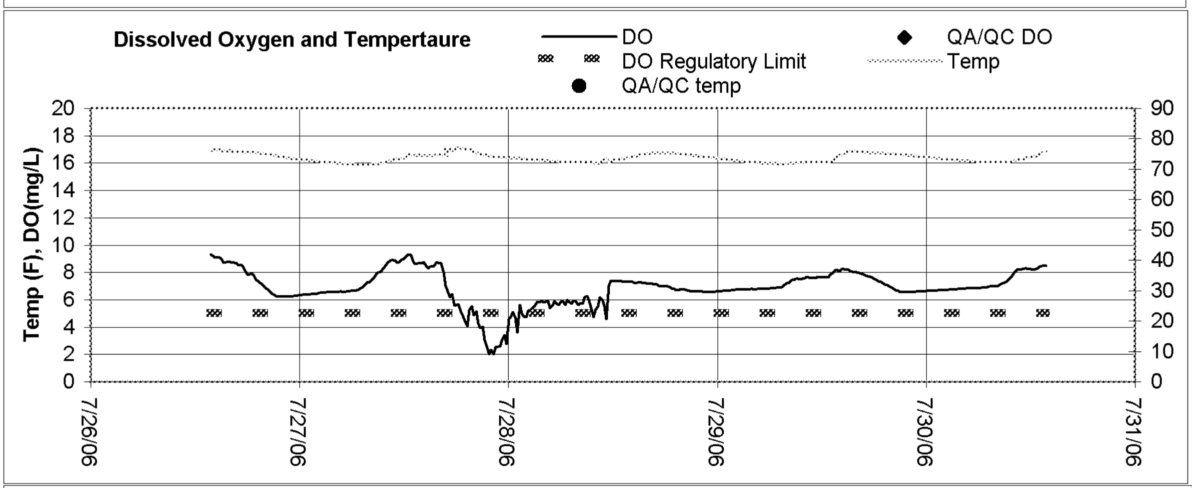


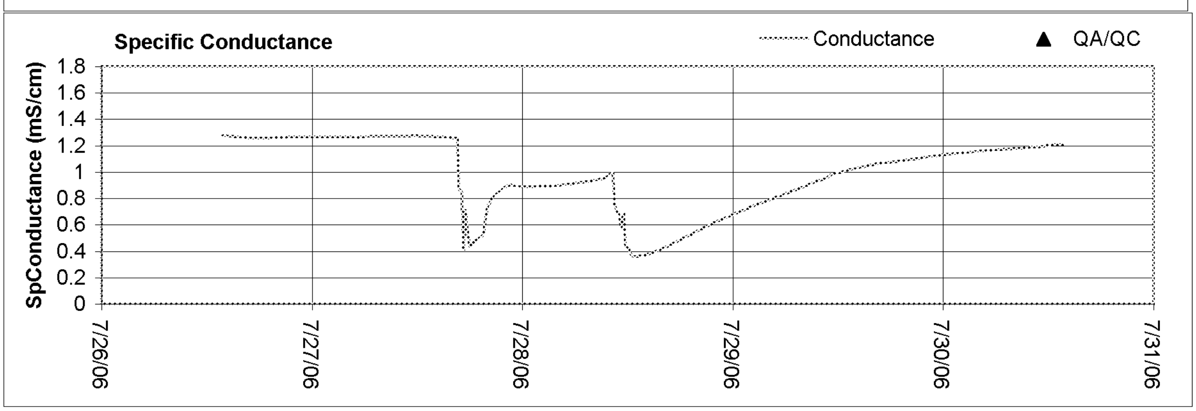
ATTACHMENT C - APPENDIX B

Saw Mill Run 1

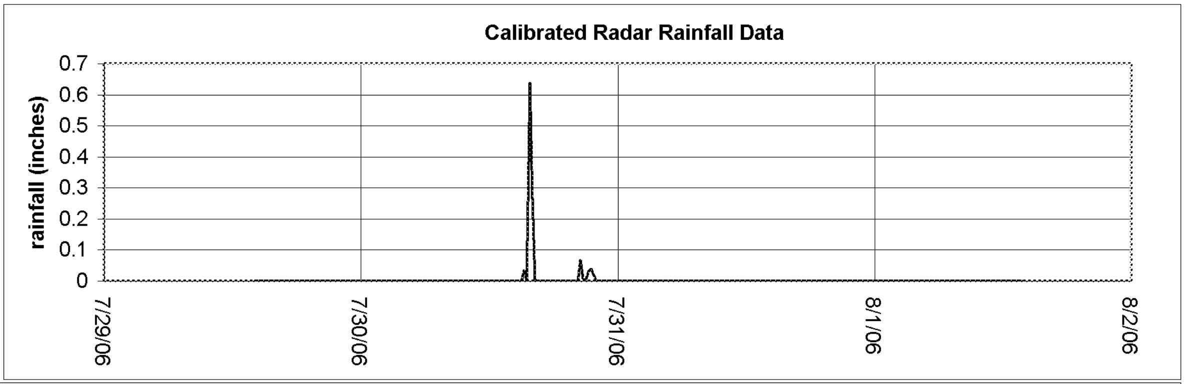


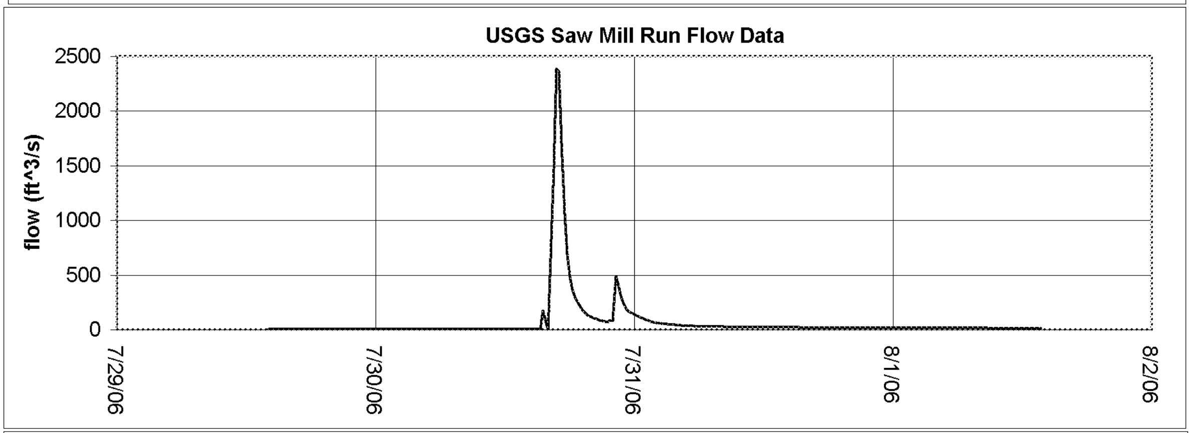


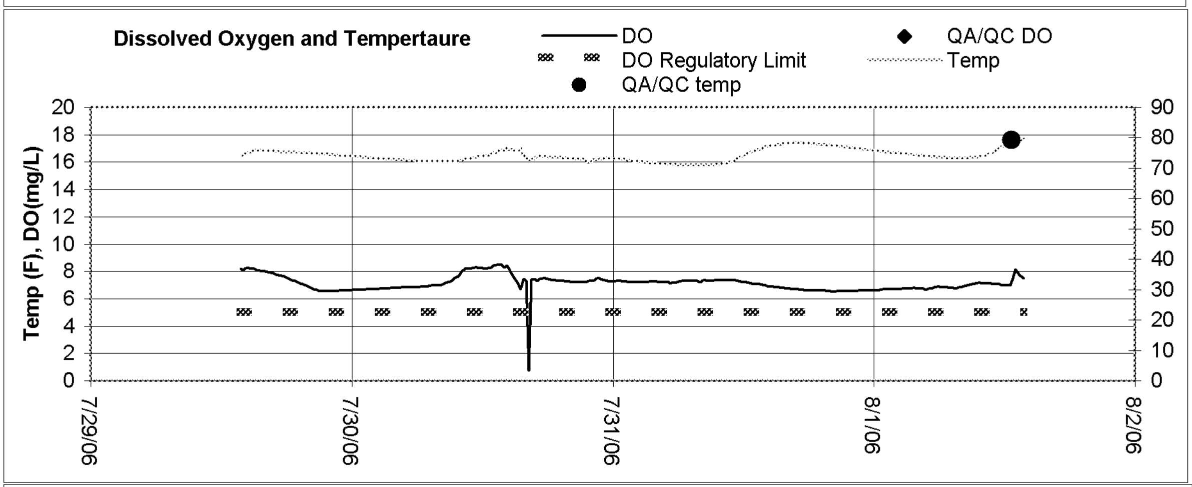


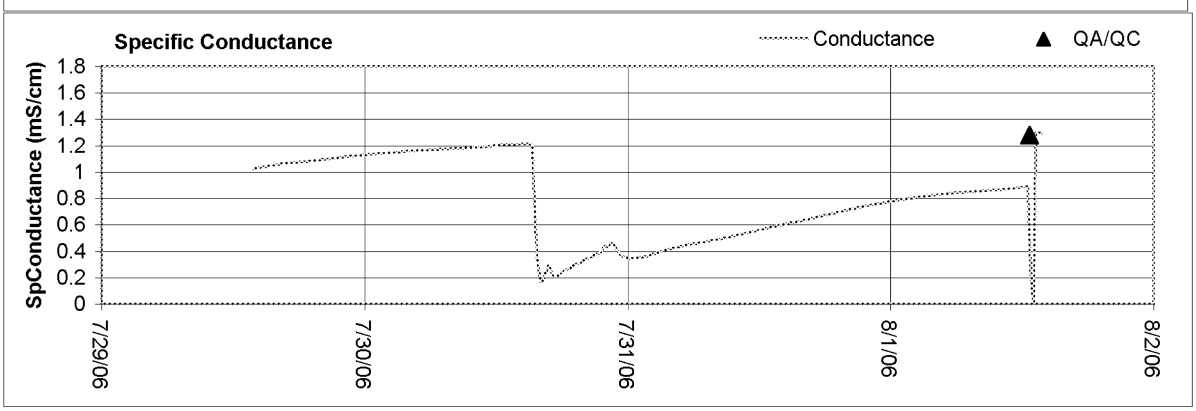


Saw Mill Run 1
(Probable CSO)

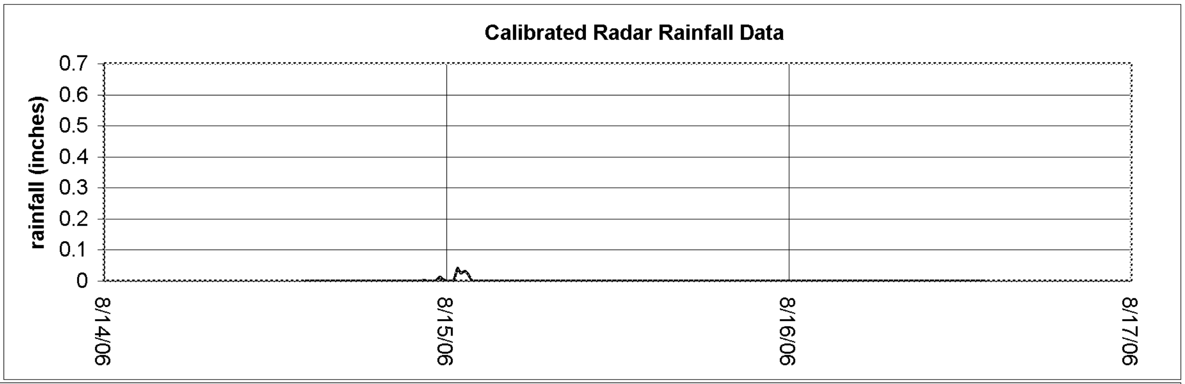


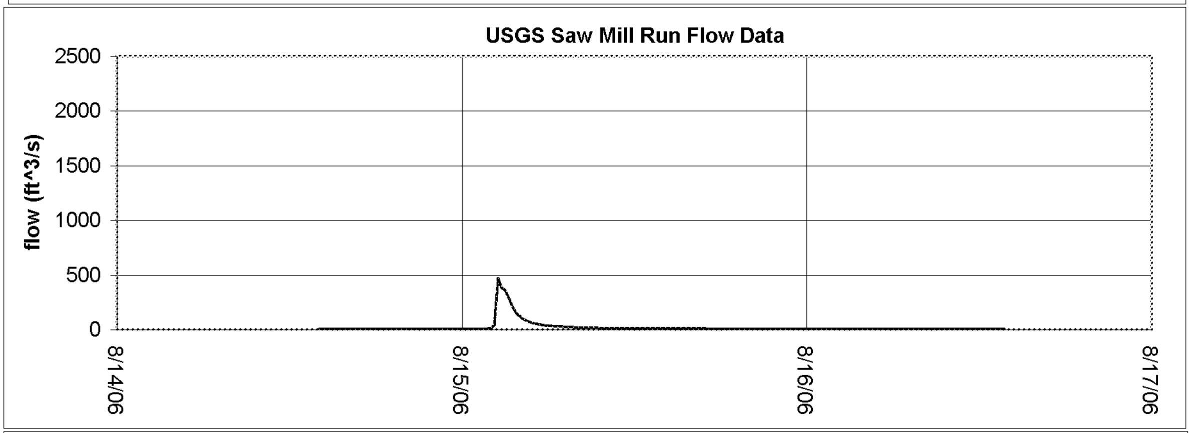


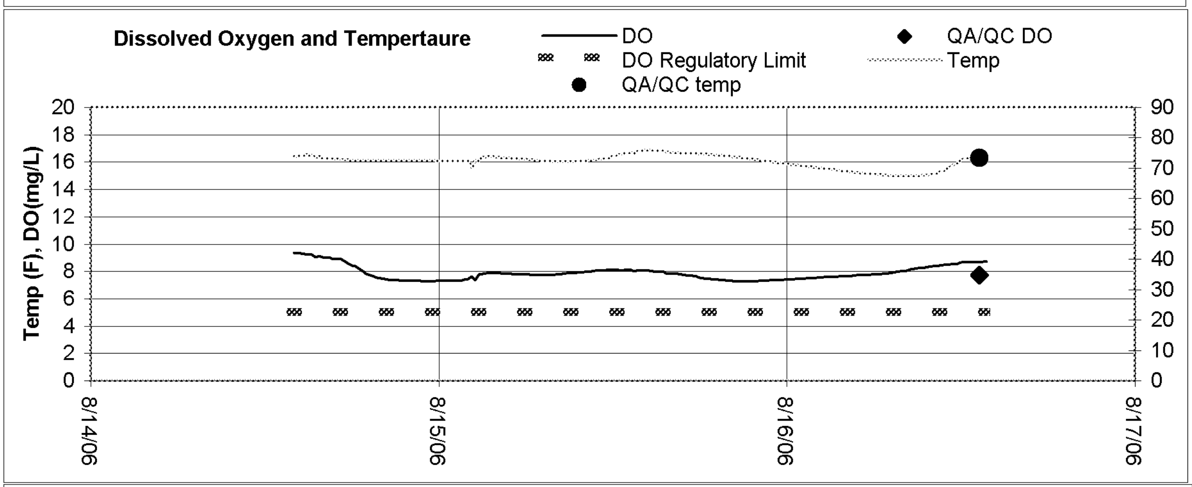


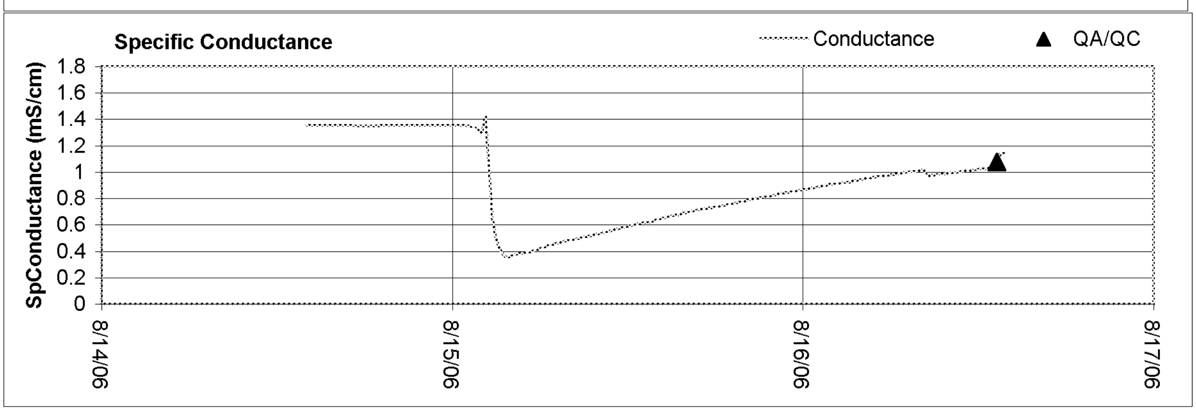


Saw Mill Run 1

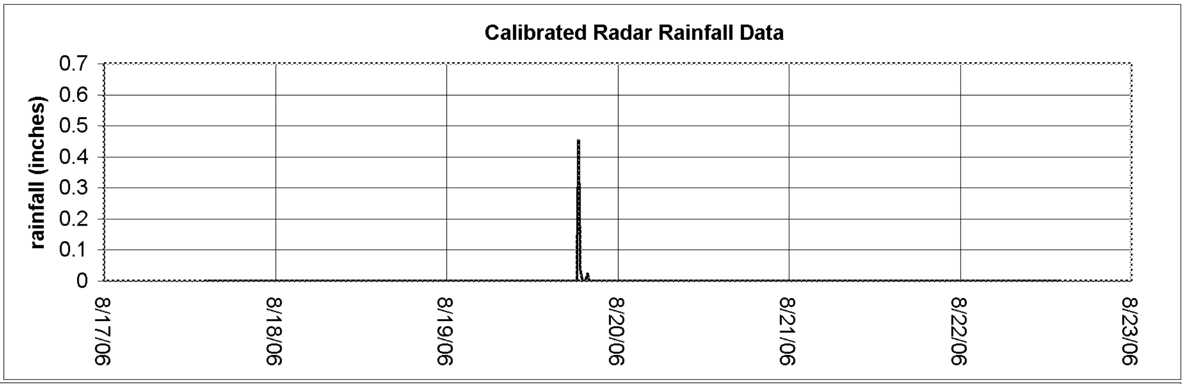


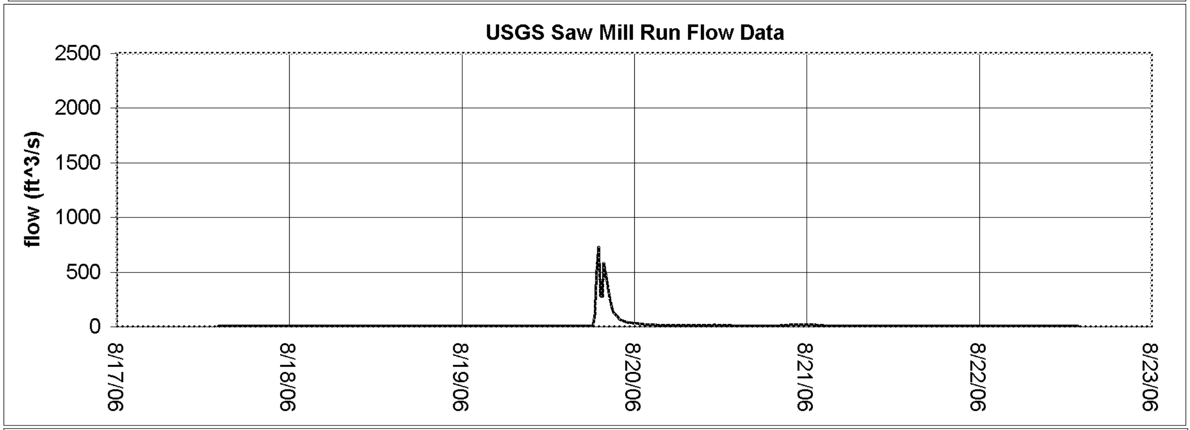


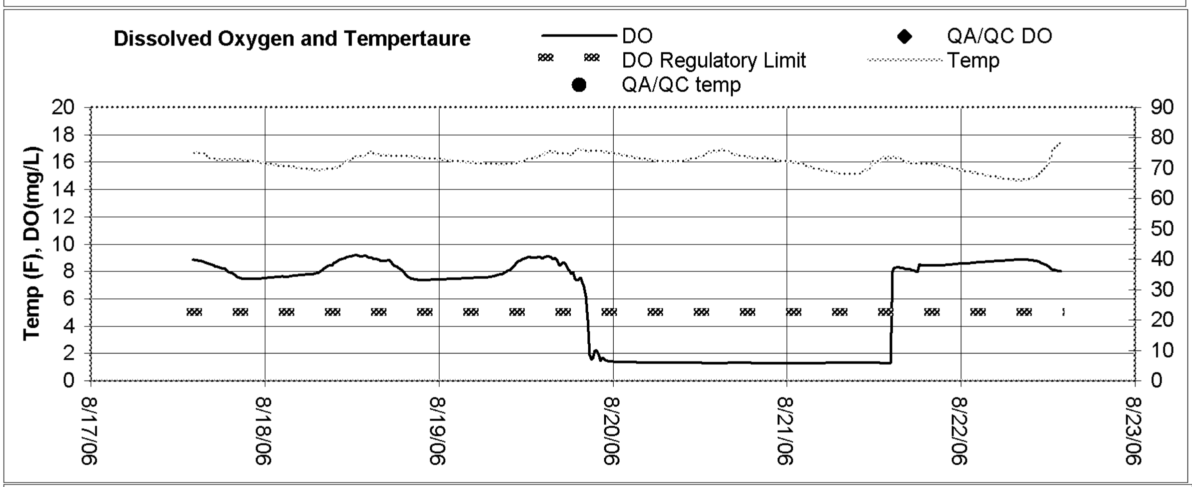


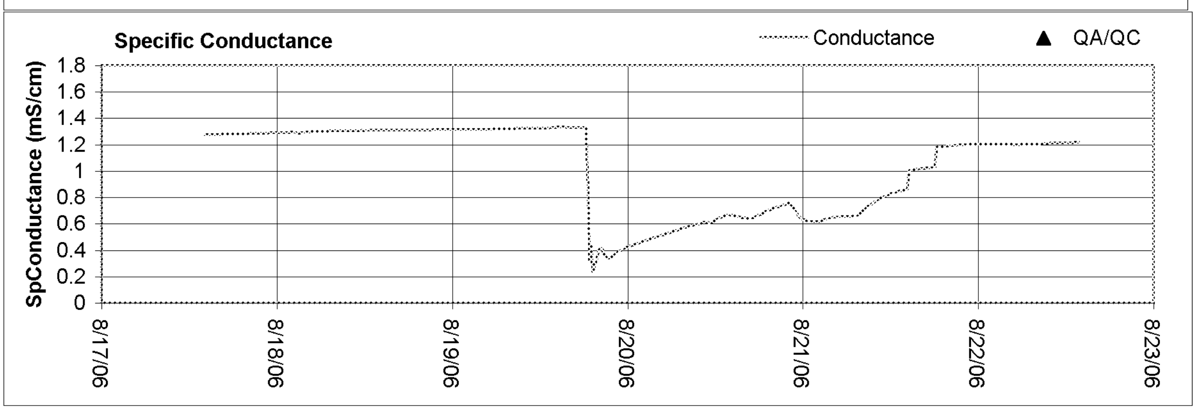


Saw Mill Run 1
(Probable CSO)

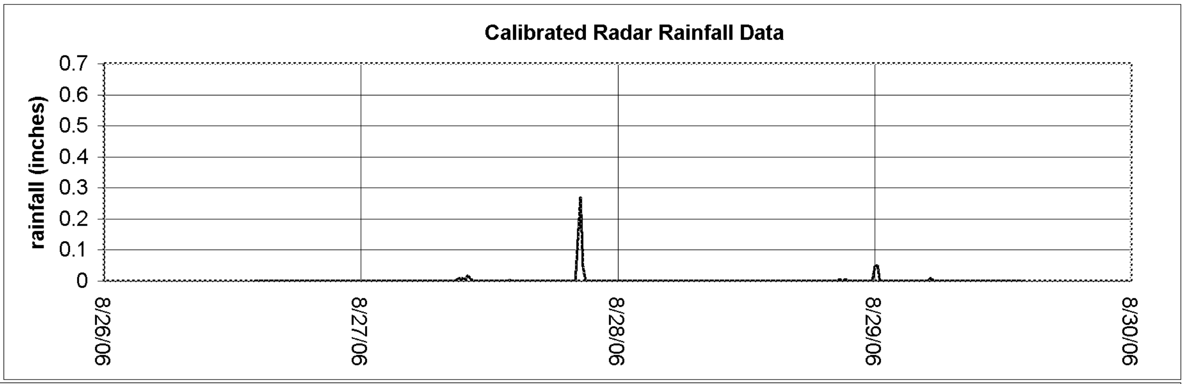


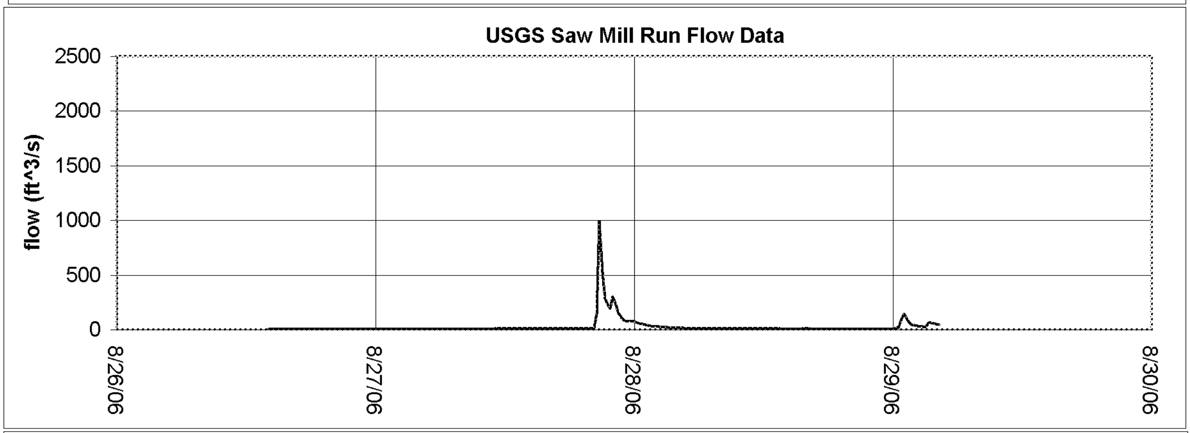


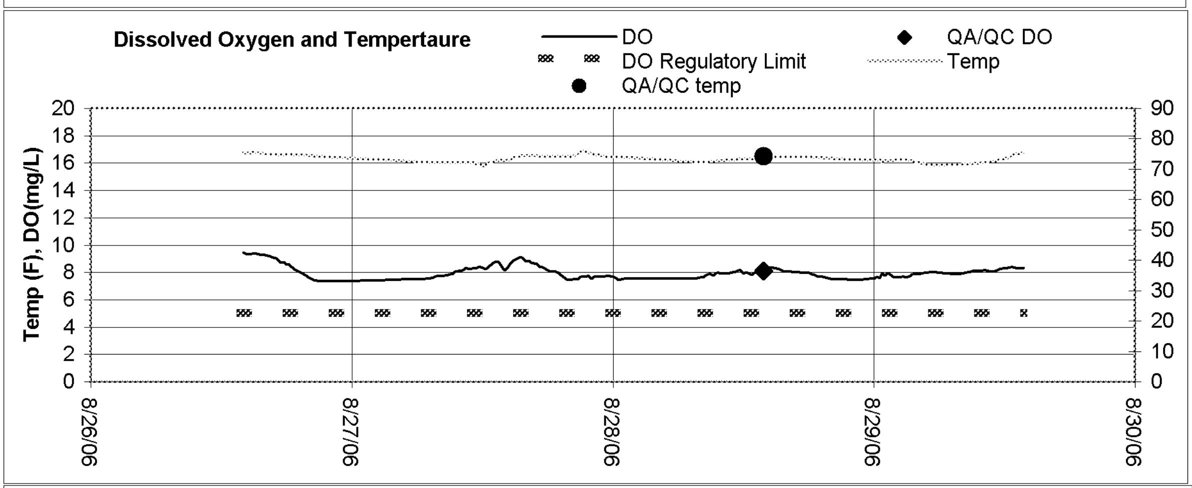


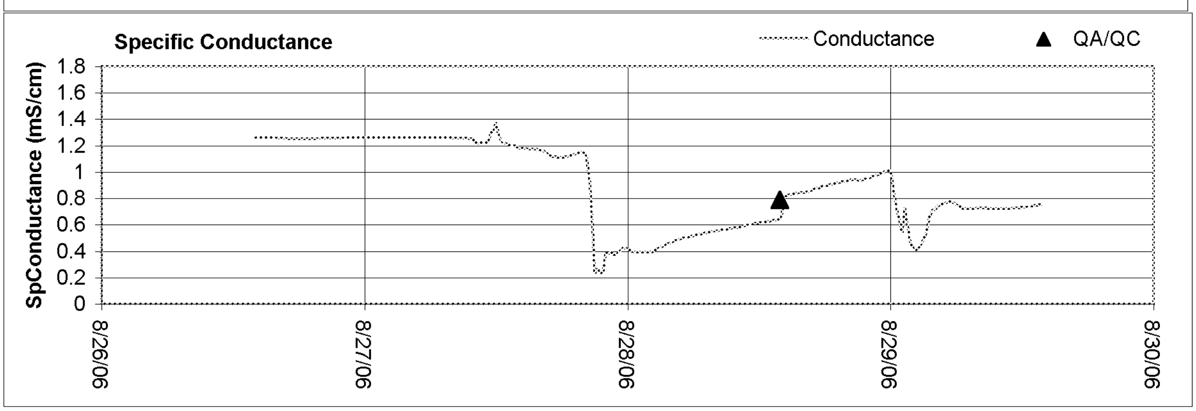


Saw Mill Run 1
(Probable CSO)

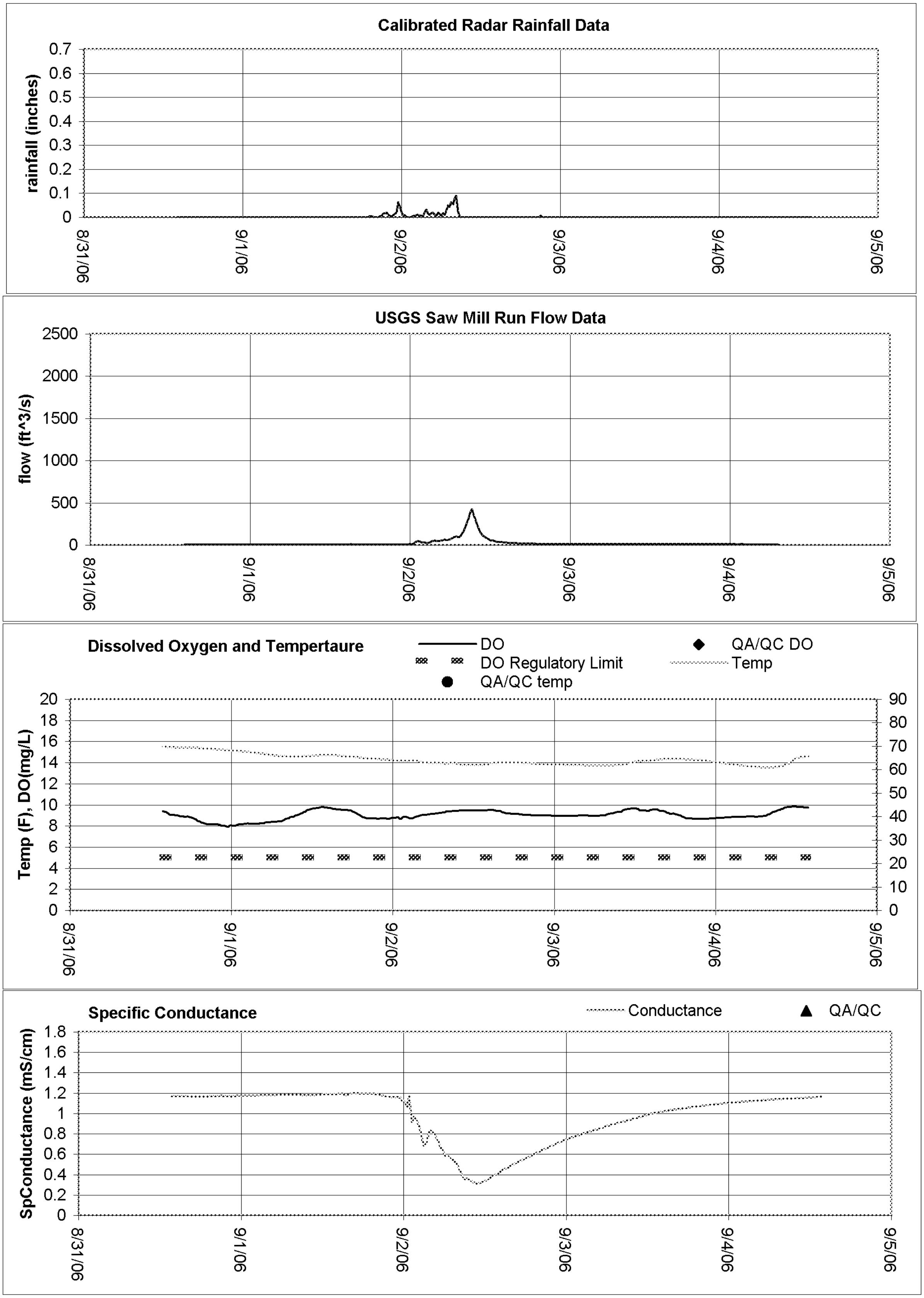




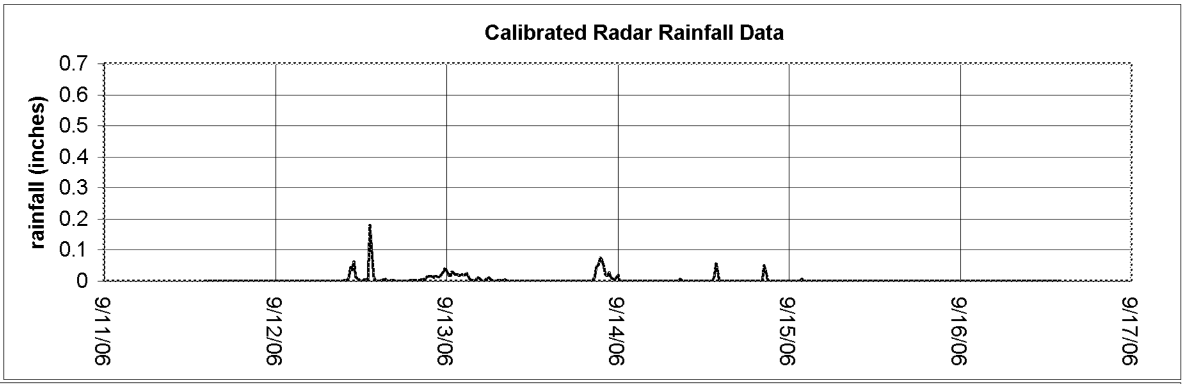


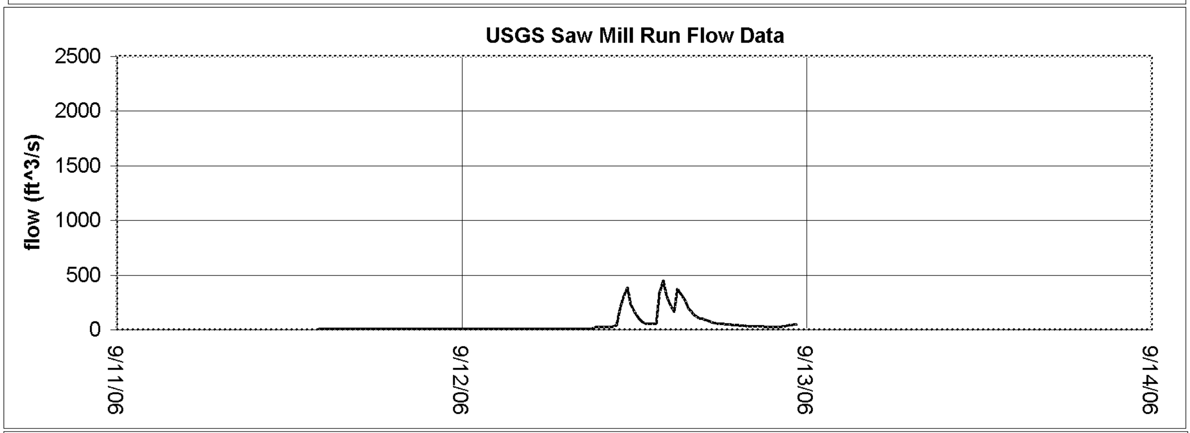


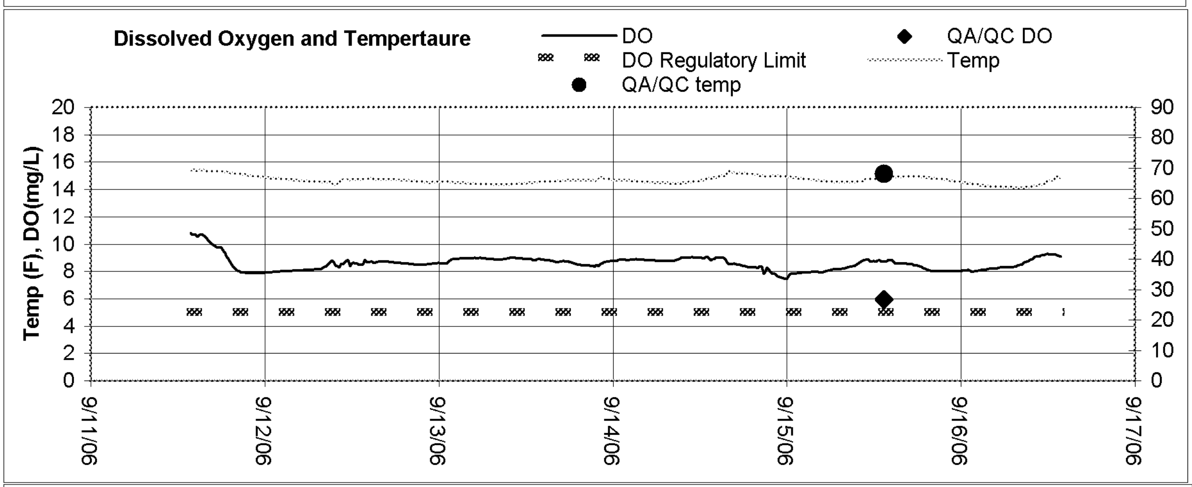
Saw Mill Run 1
(Probable CSO)

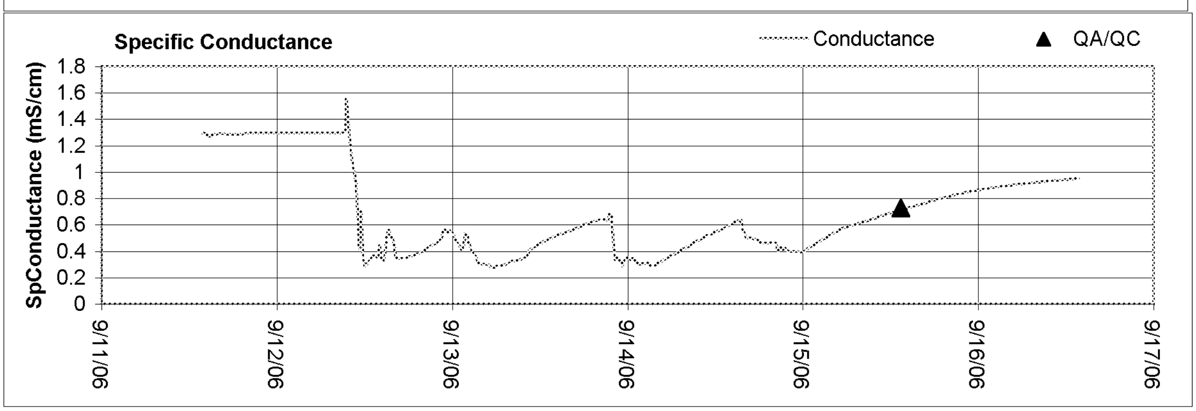


Saw Mill Run 1
(Probable CSO)



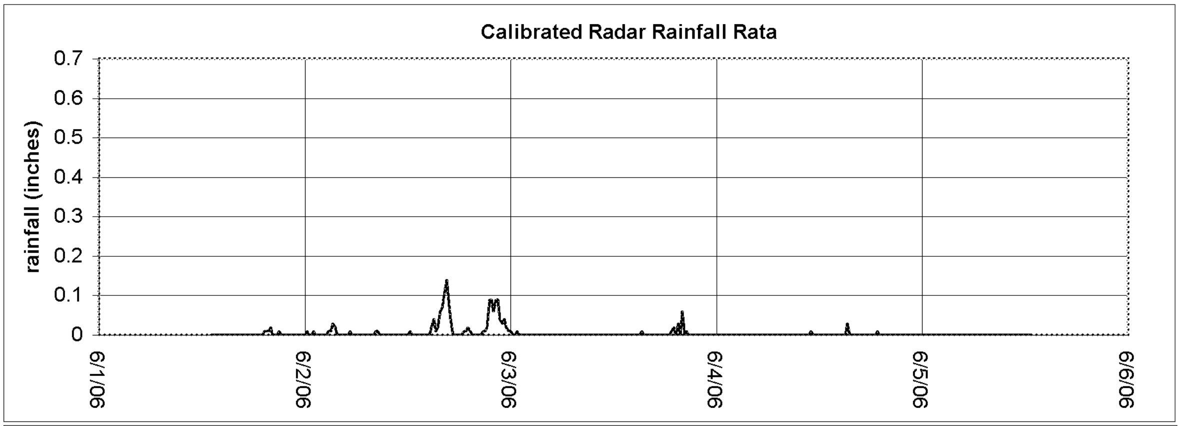


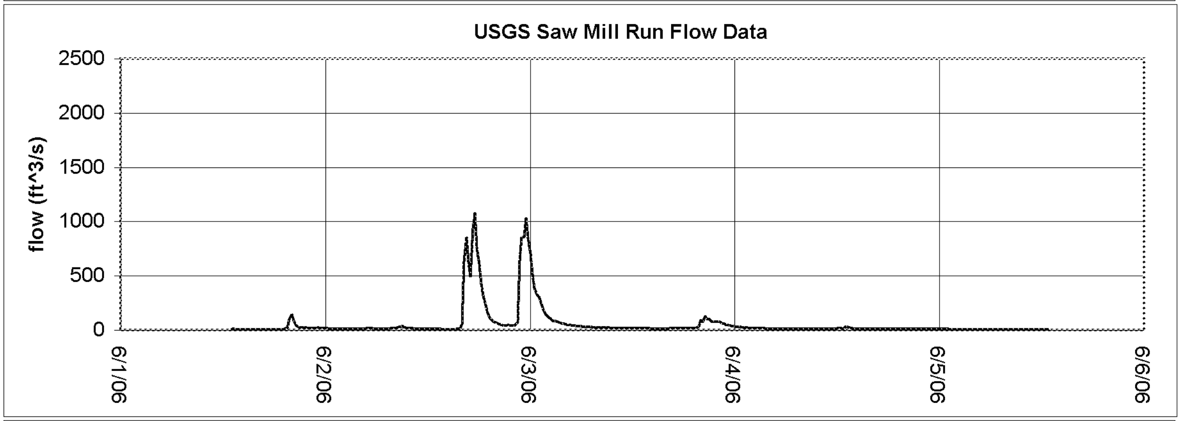


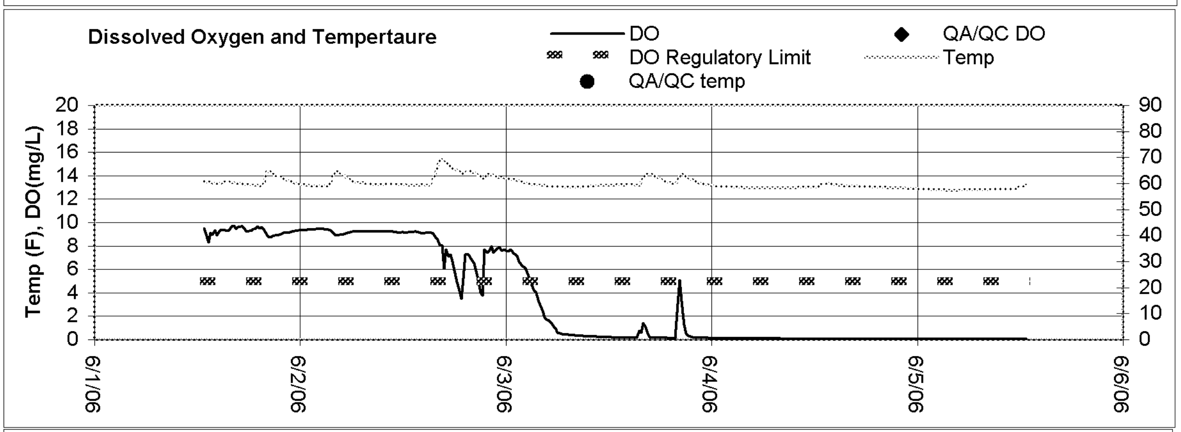


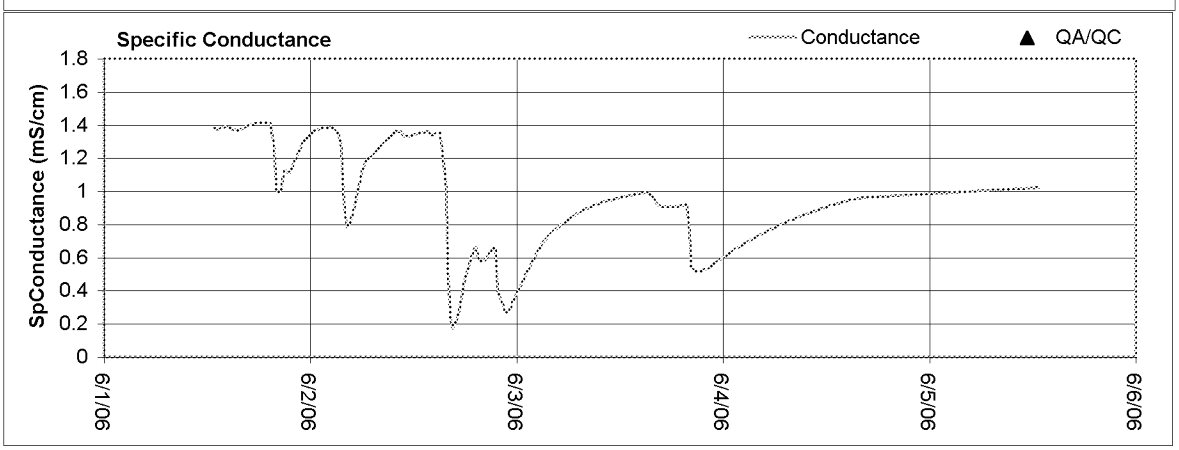
SAW MILL RUN (SM-SW-2)
WET WETHER DATA GRAPHS

Saw Mill Run 2
(Probable CSO)



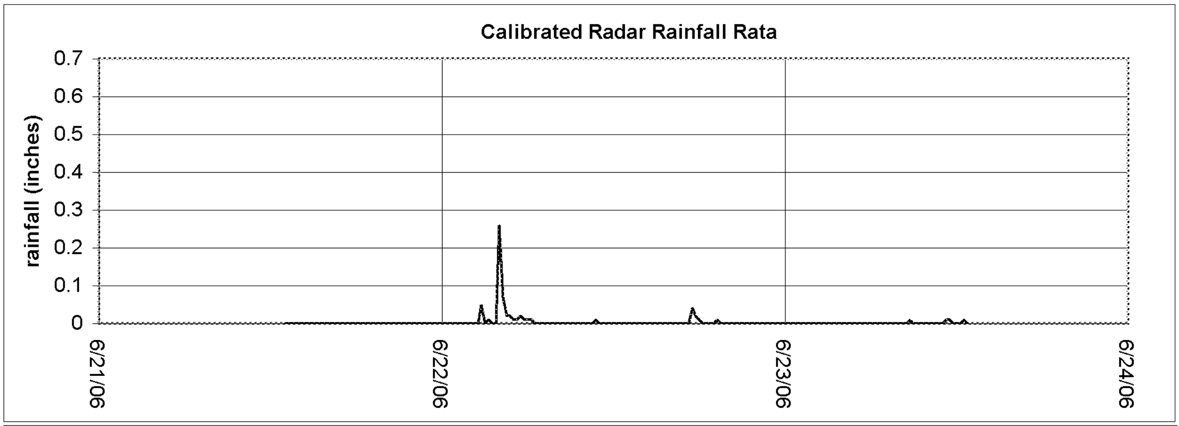


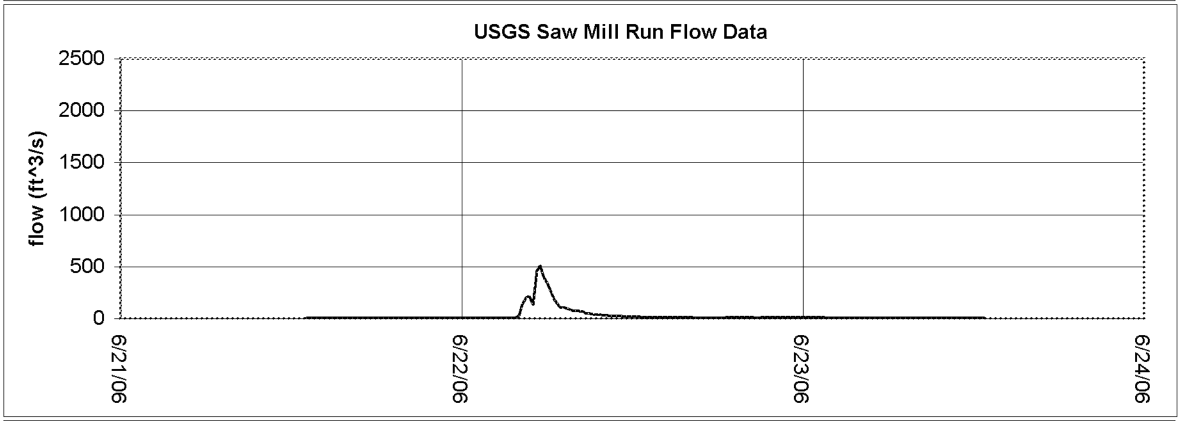


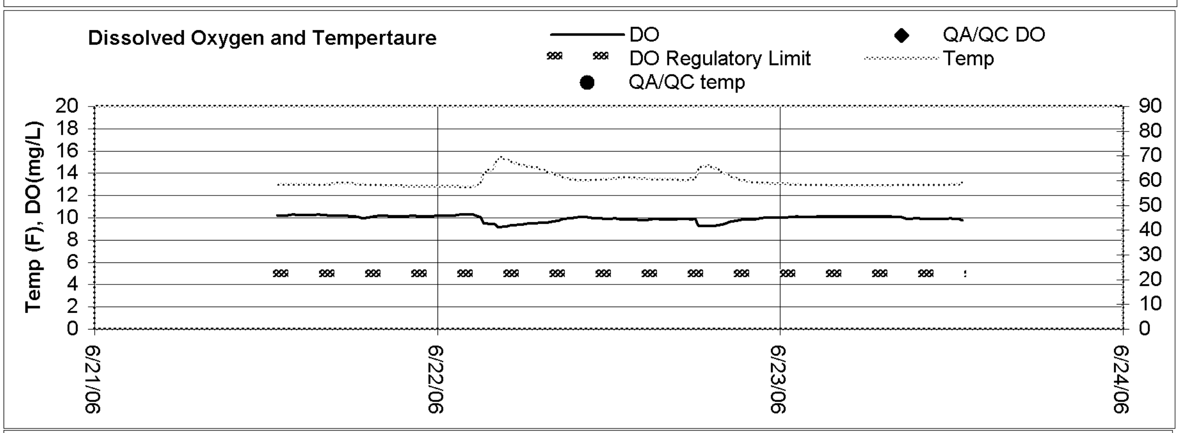


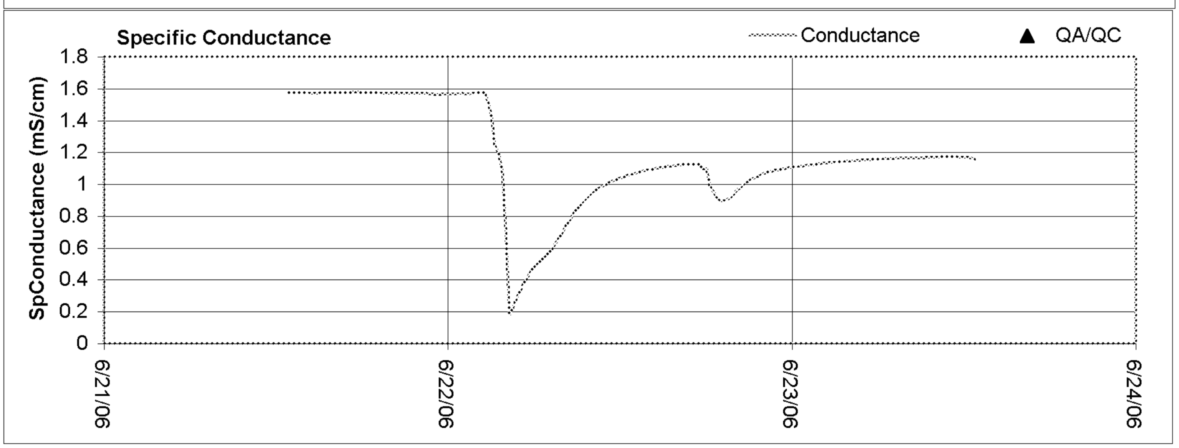
ATTACHMENT C - APPENDIX B

Saw Mill Run 2
(Probable CSO)

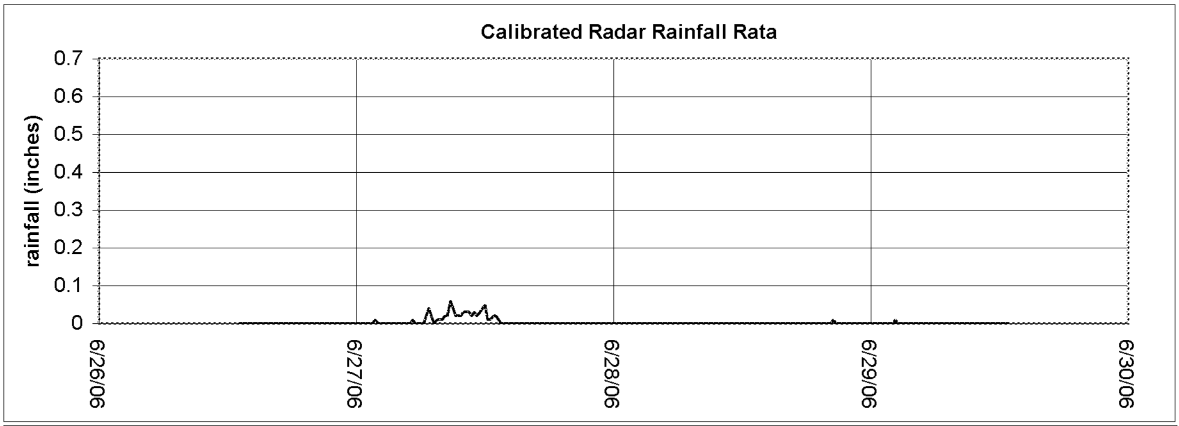


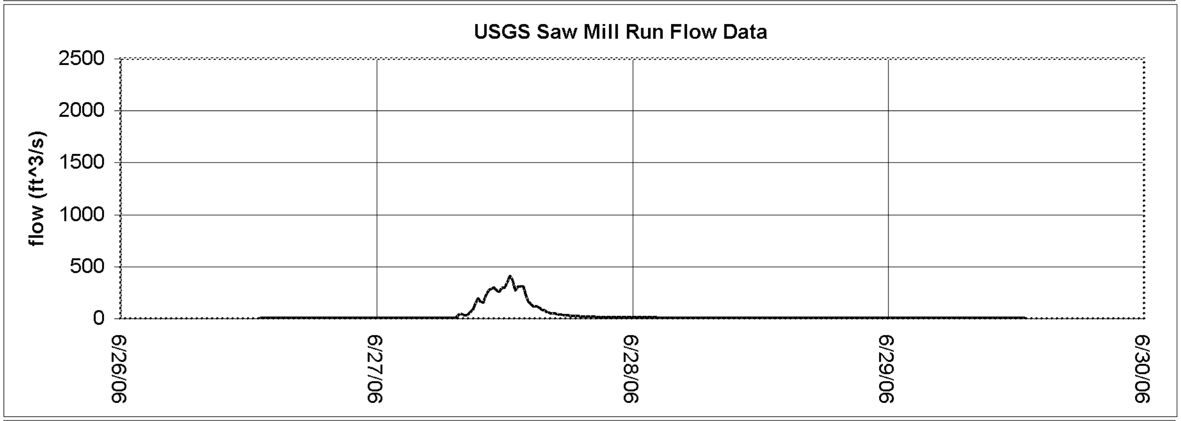


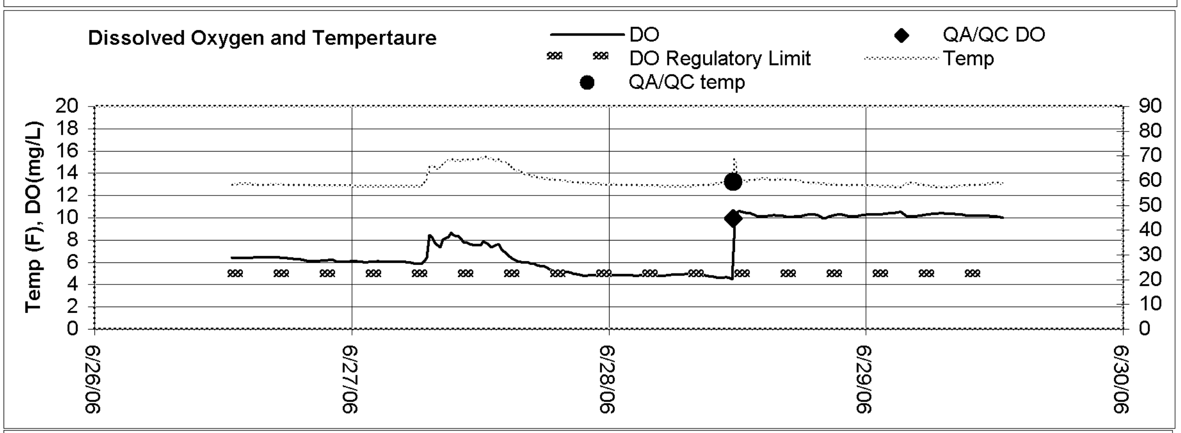


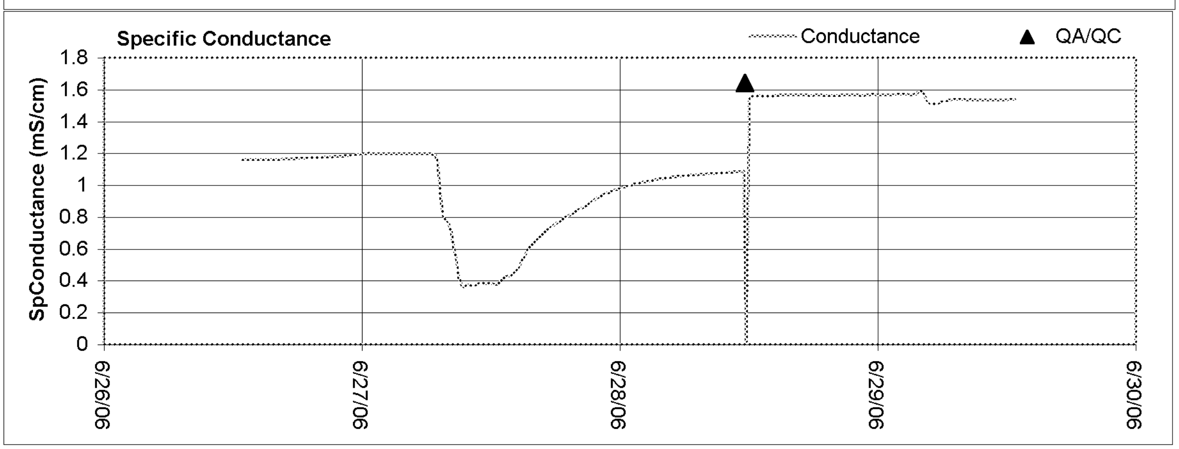


Saw Mill Run 2
(Probable CSO)

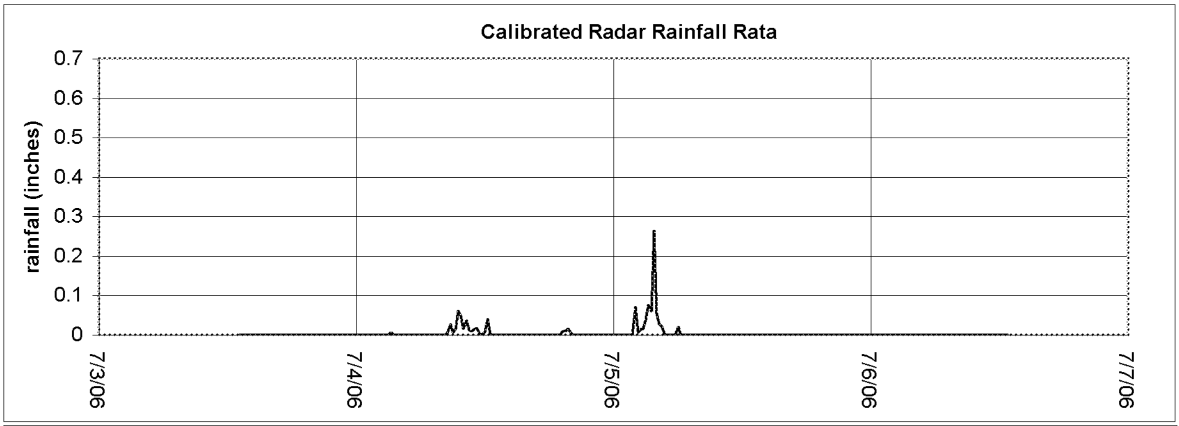


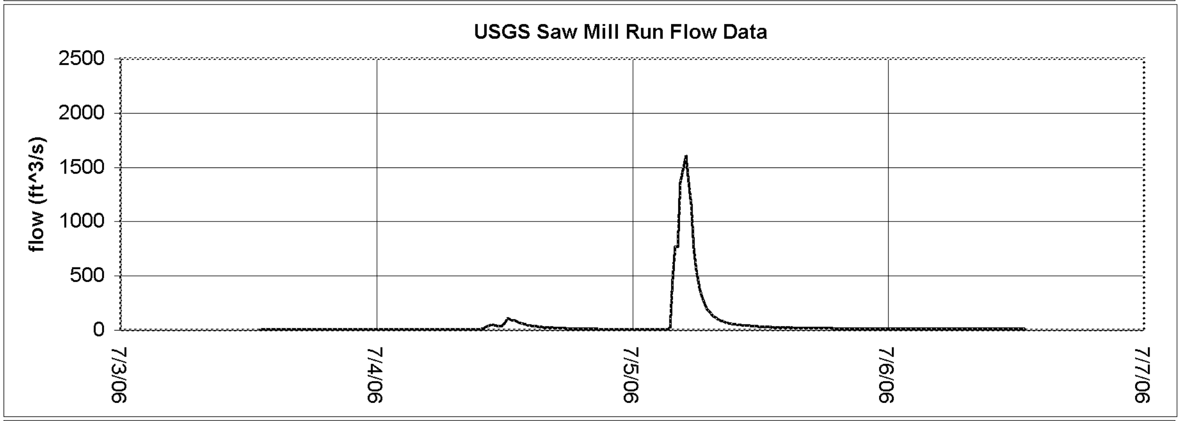


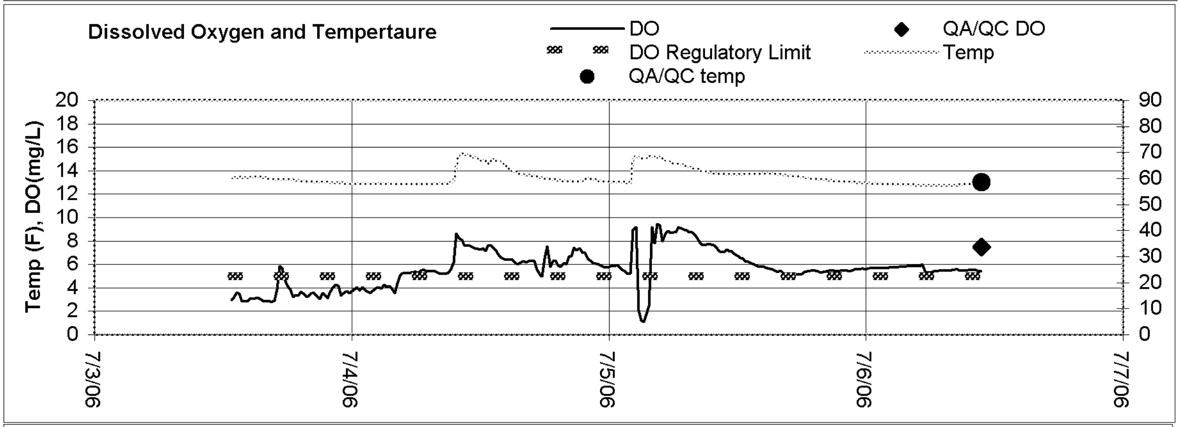


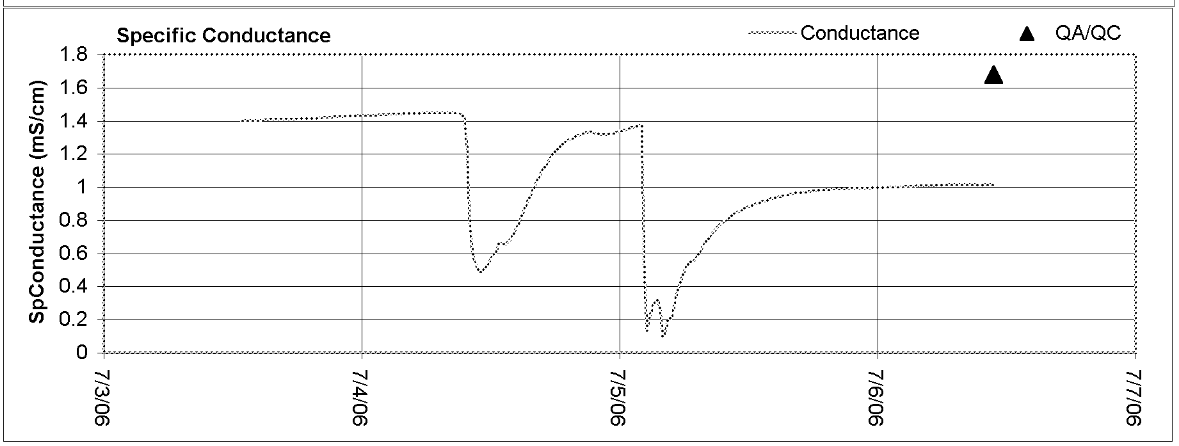


Saw Mill Run 2
(Probable CSO)

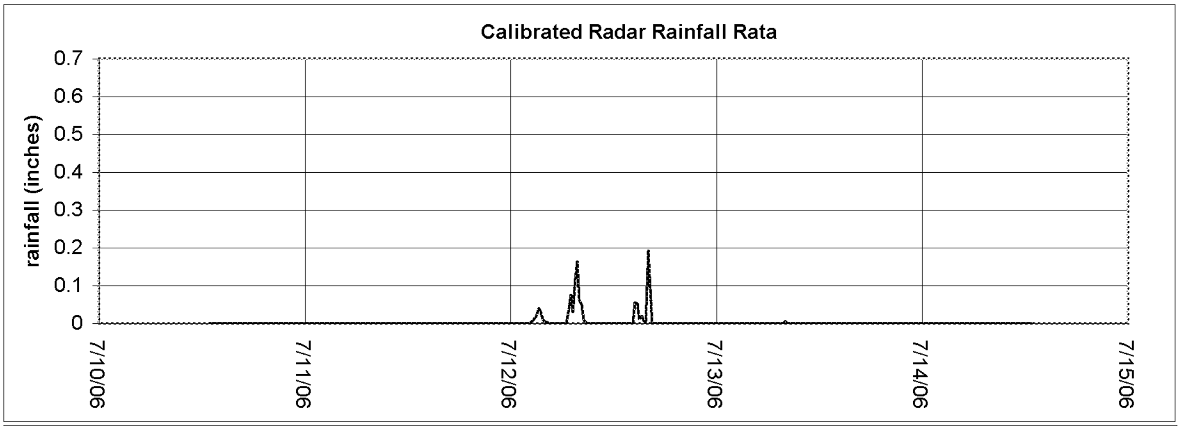


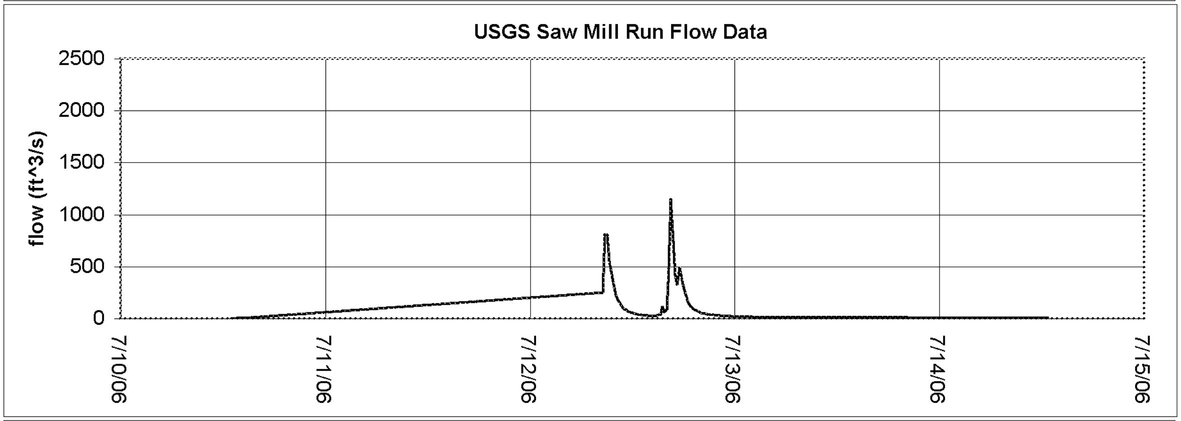


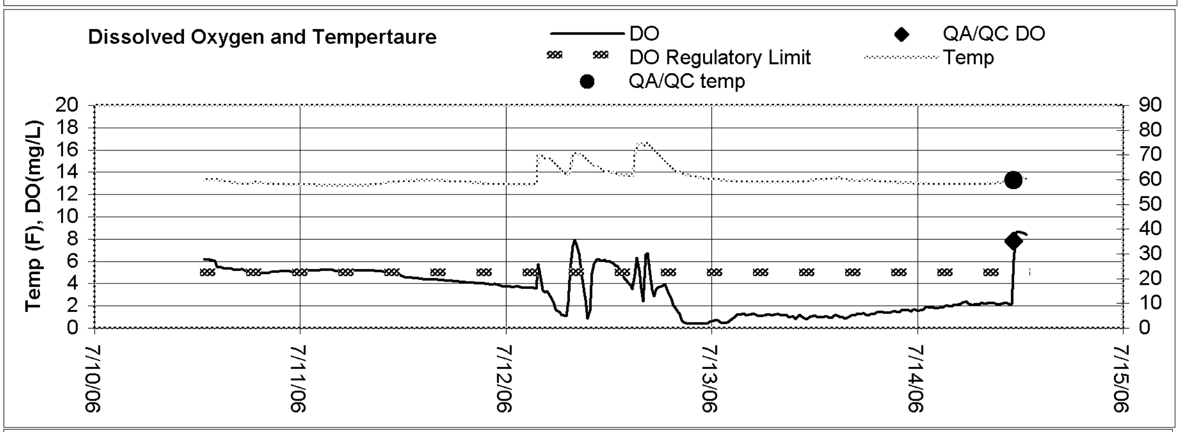


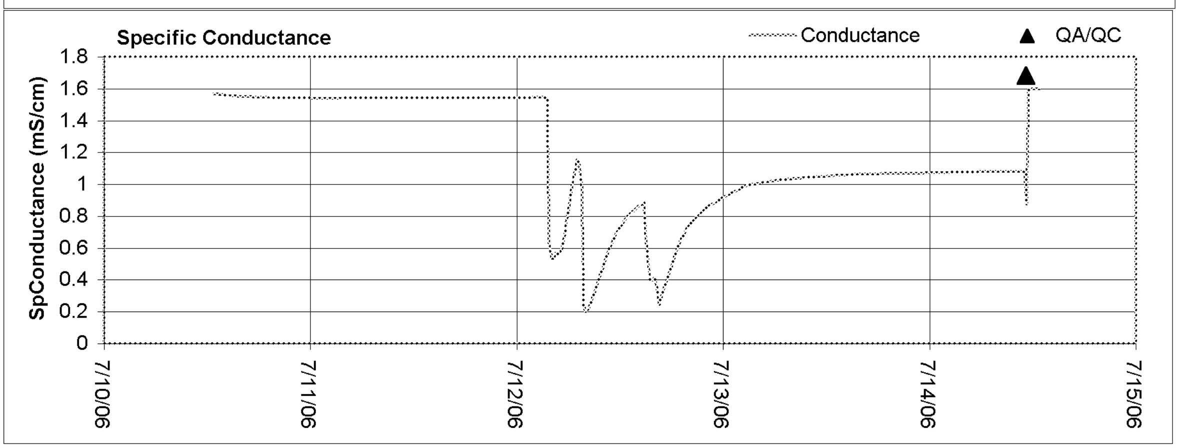


Saw Mill Run 2
(Probable CSO)

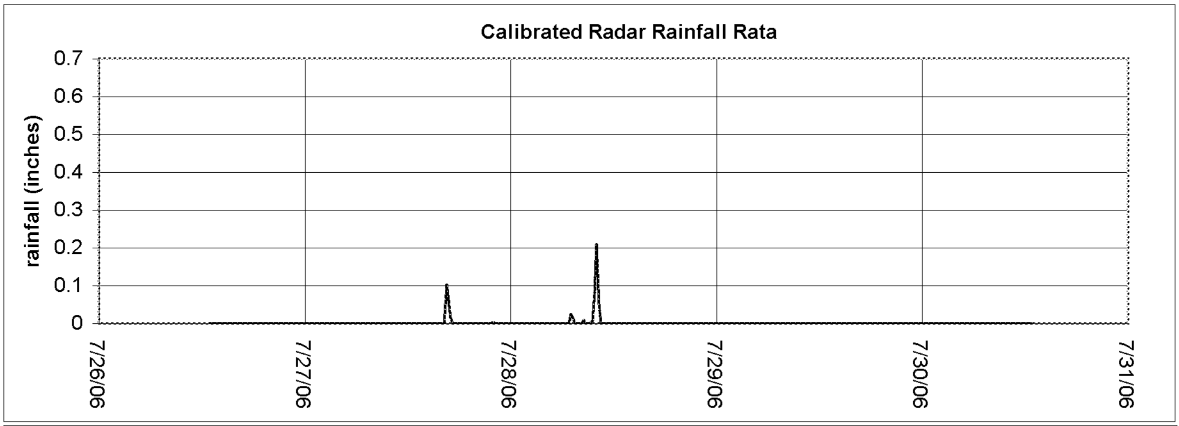


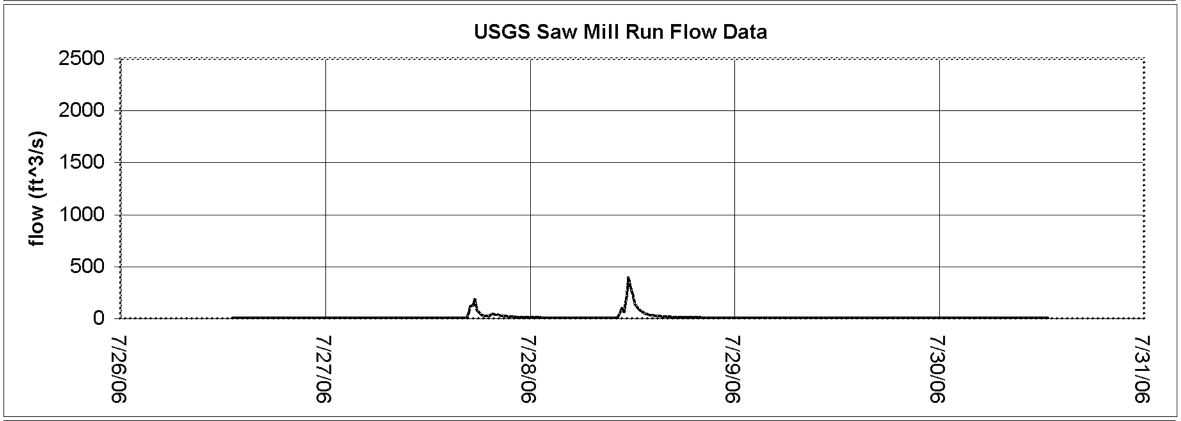


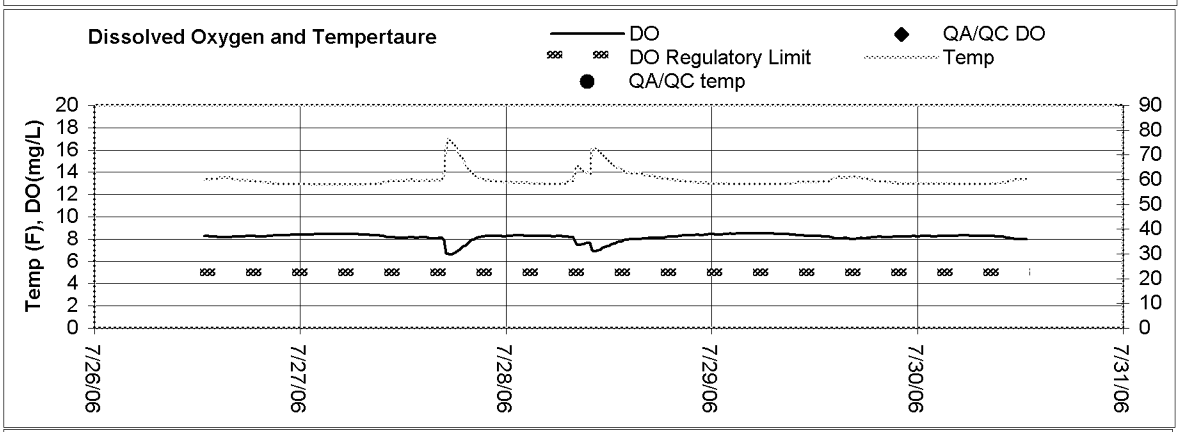


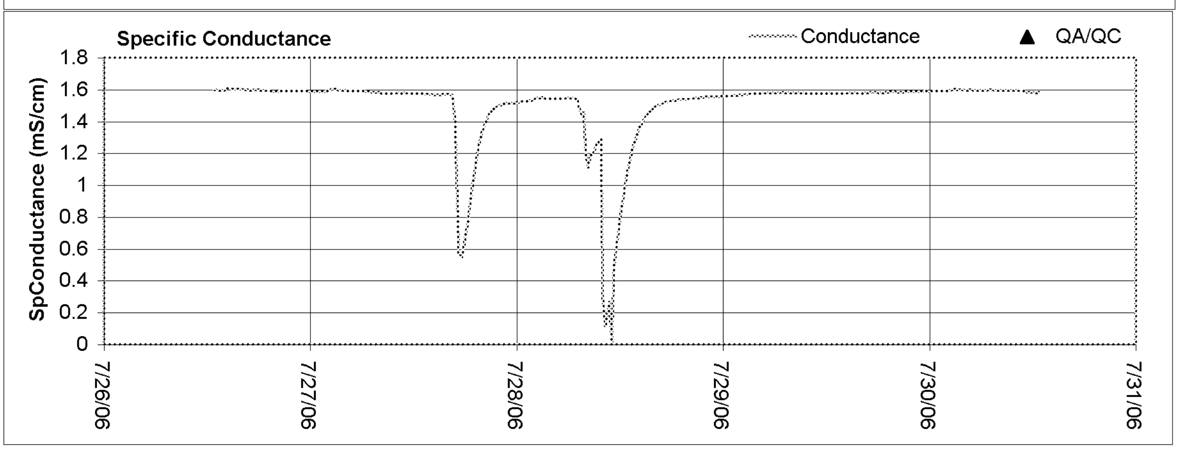


Saw Mill Run 2









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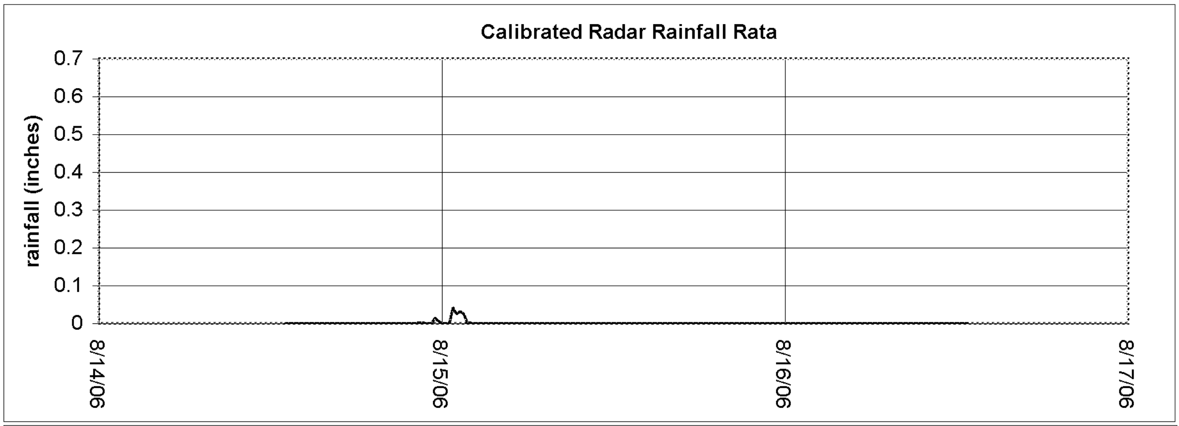

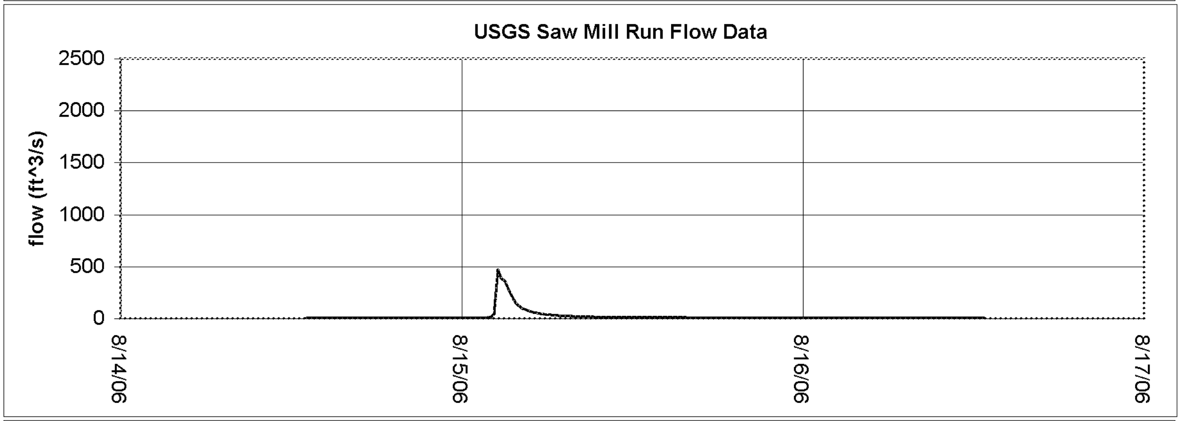

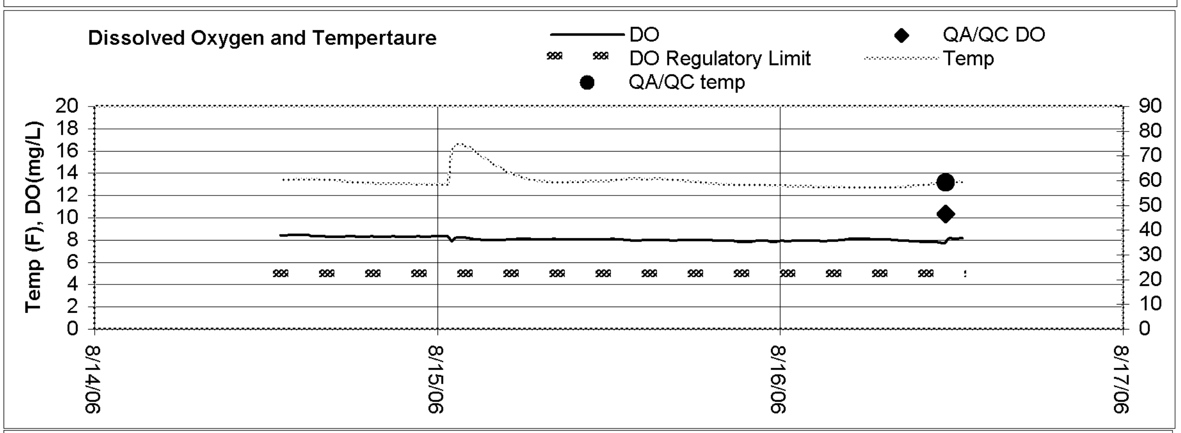

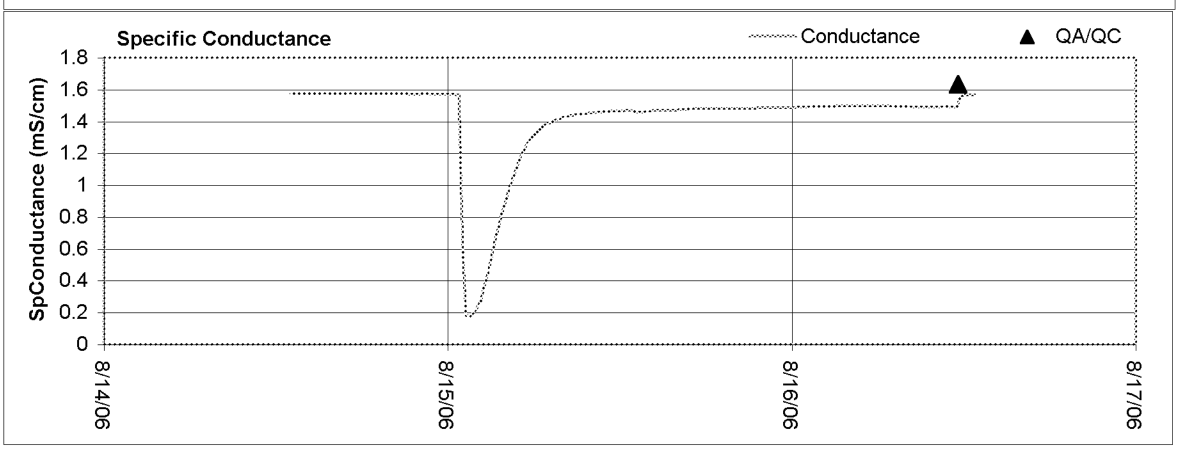

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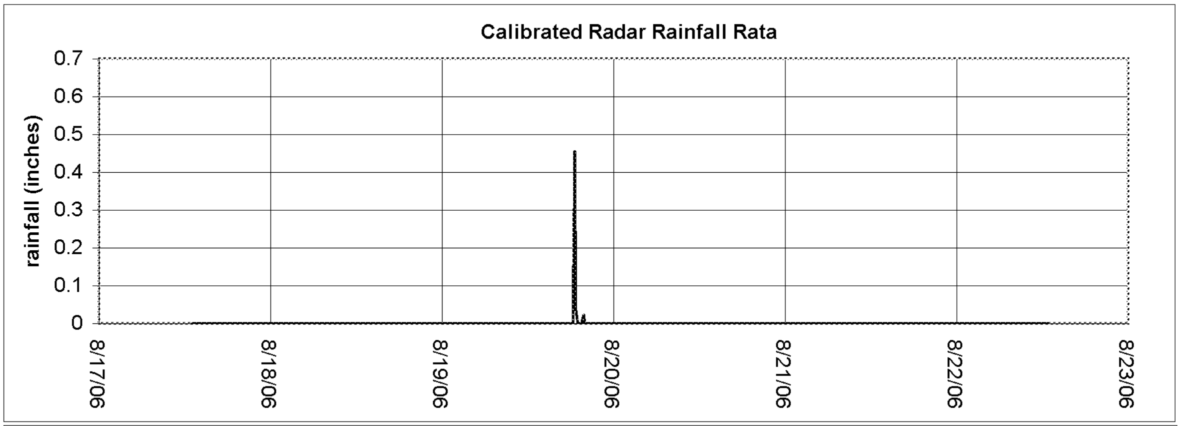

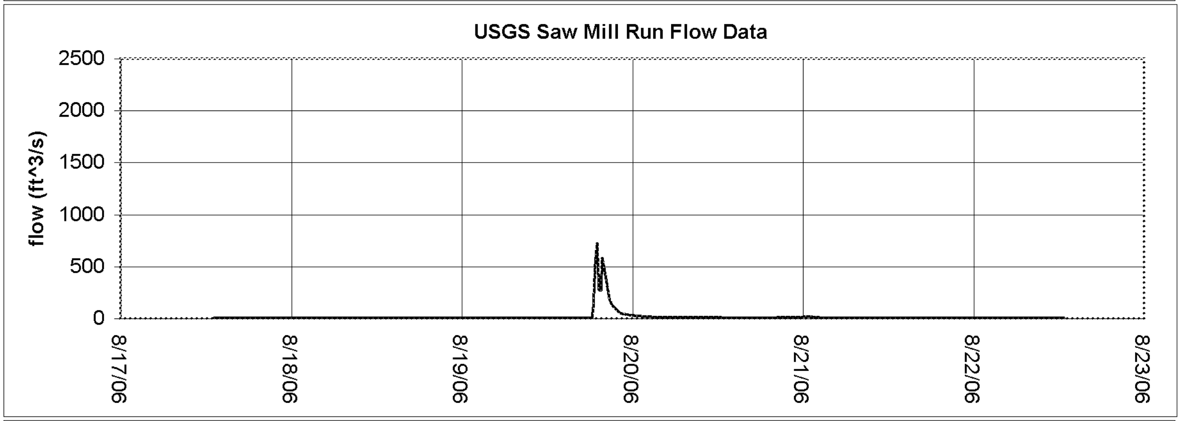

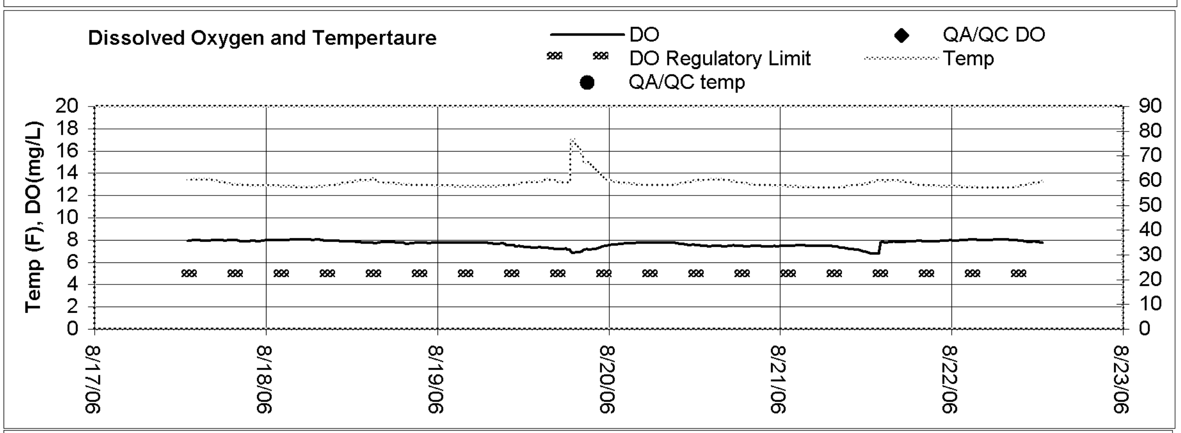

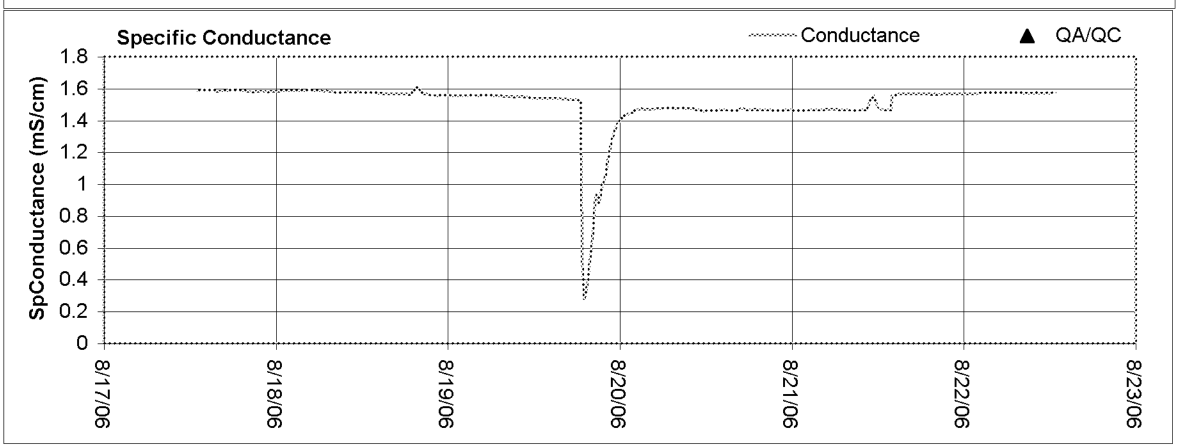

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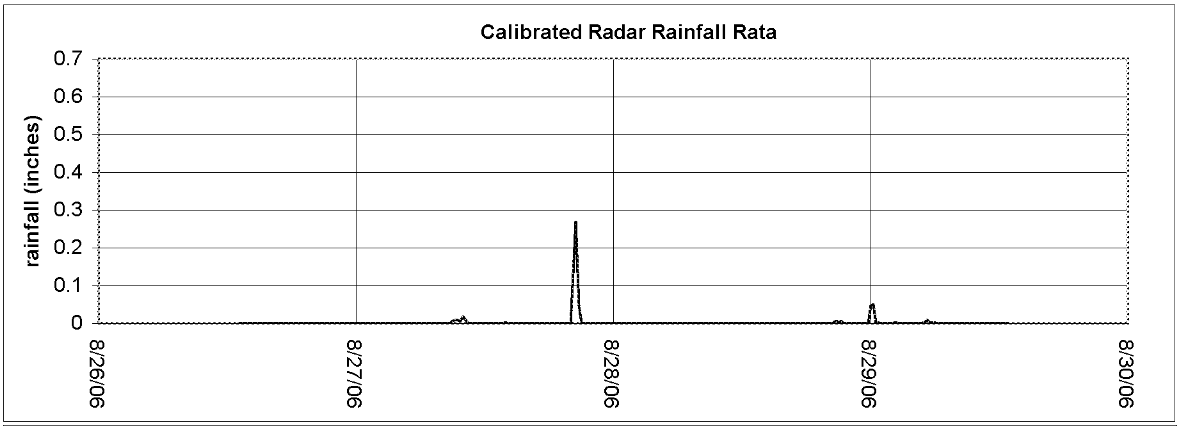

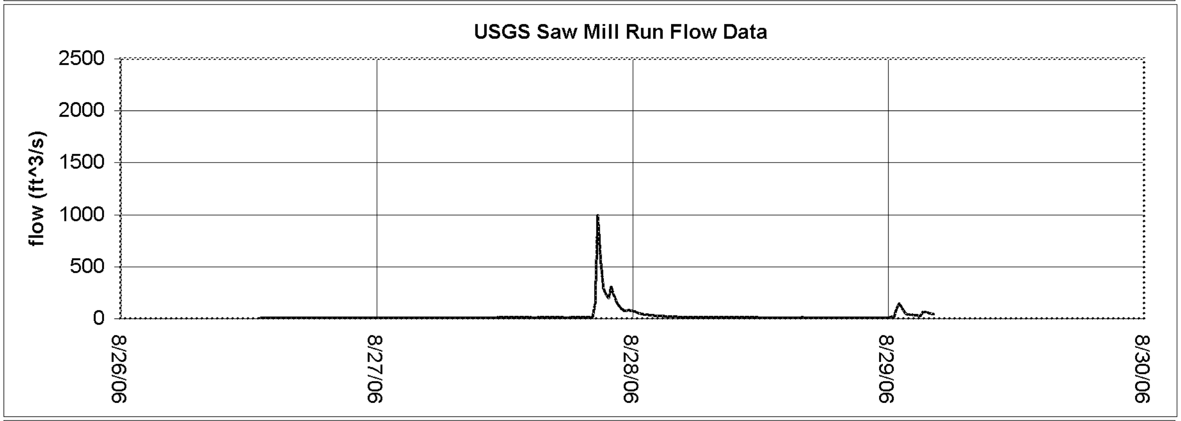

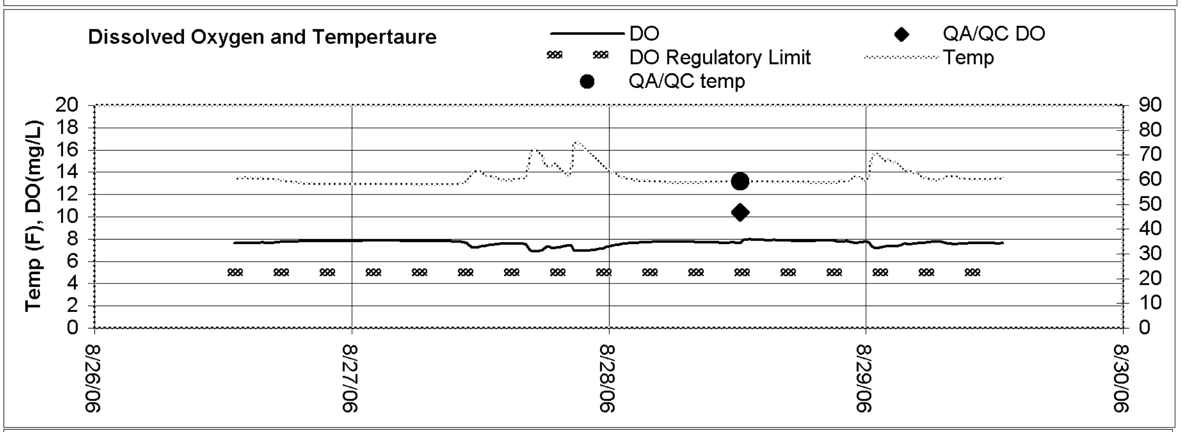

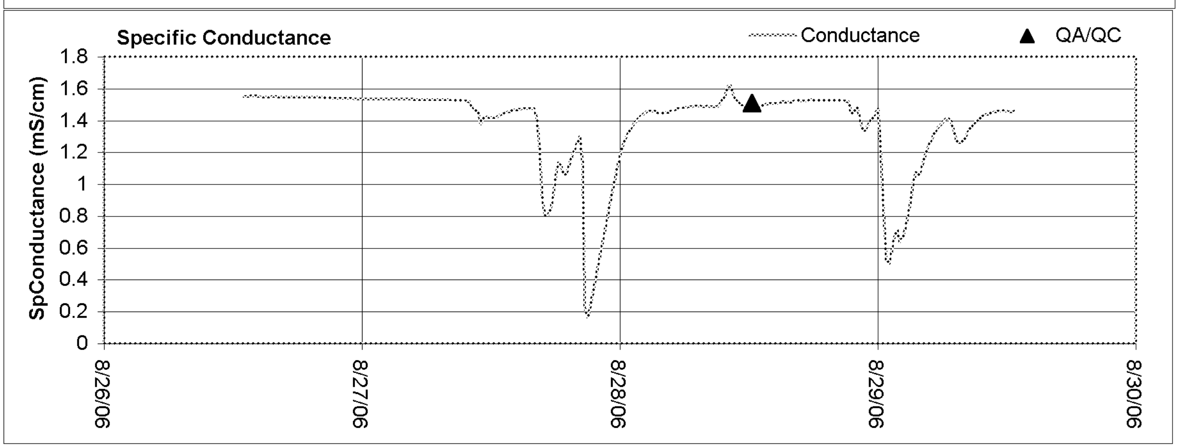

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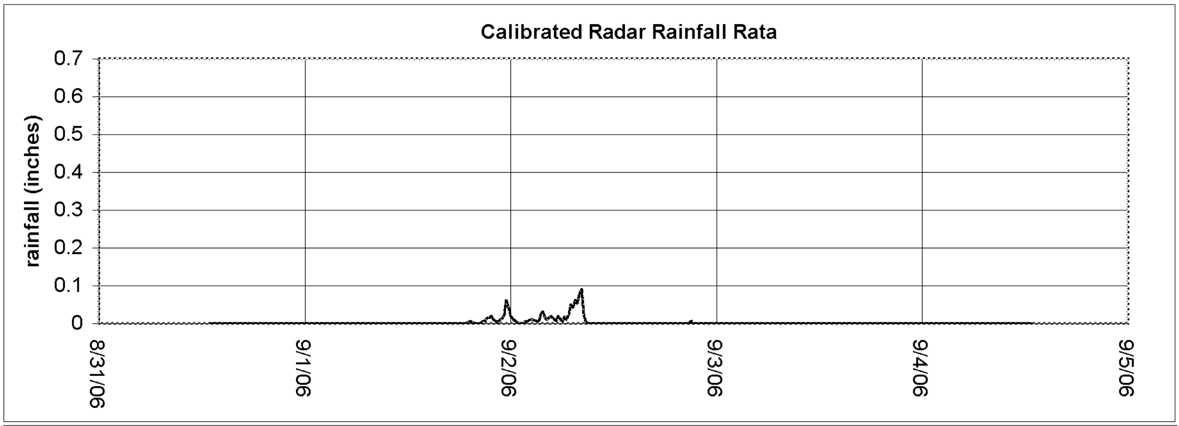

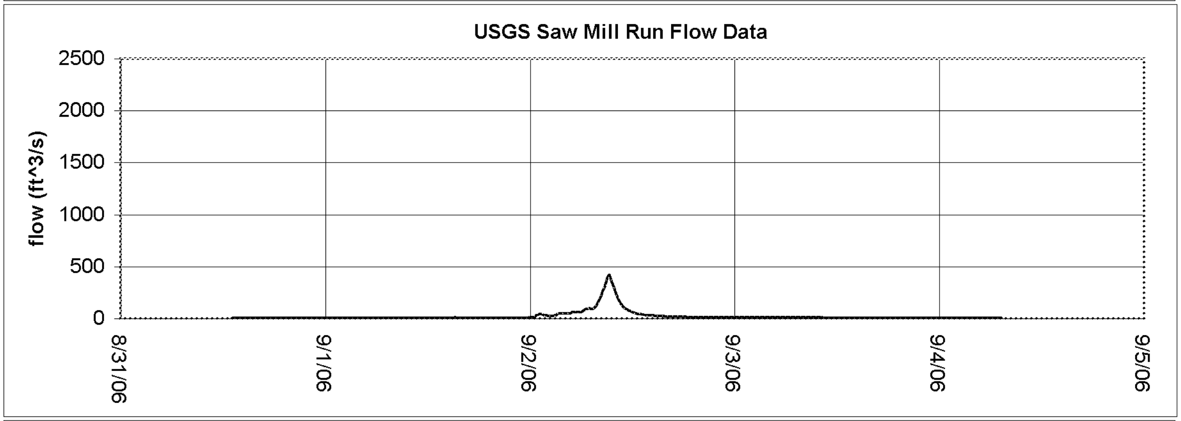

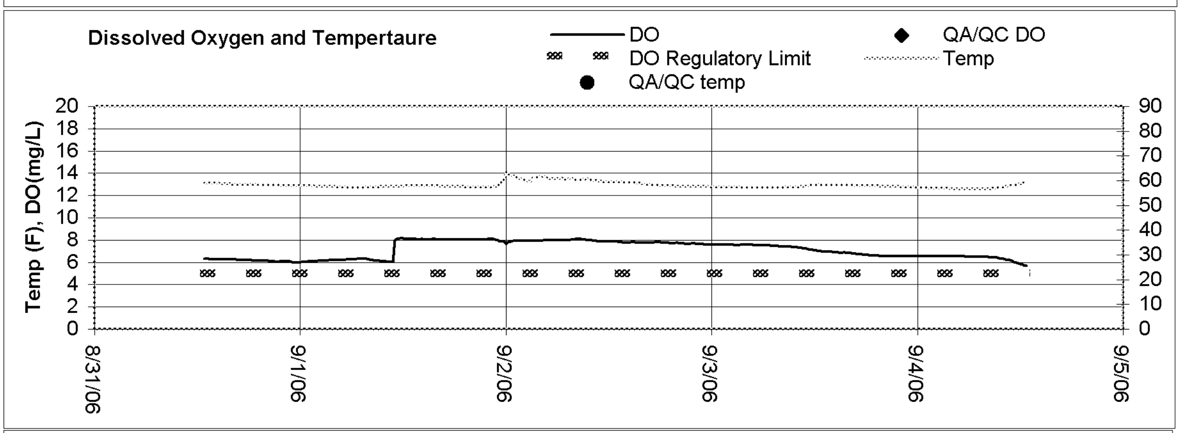

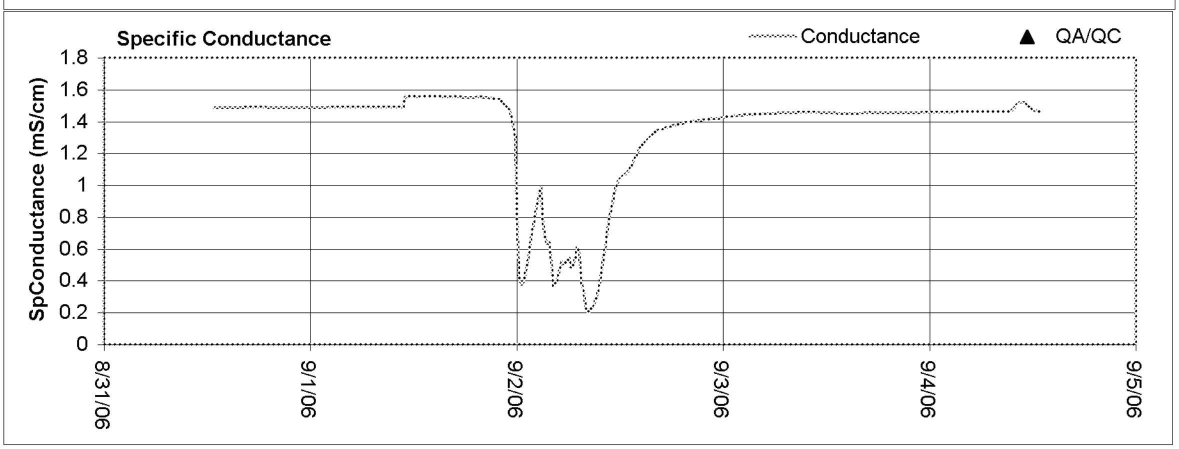

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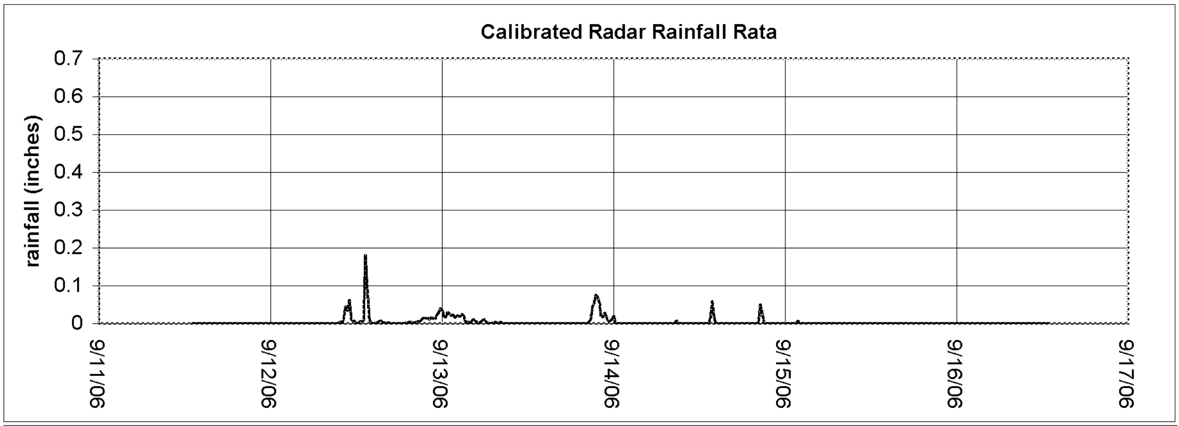

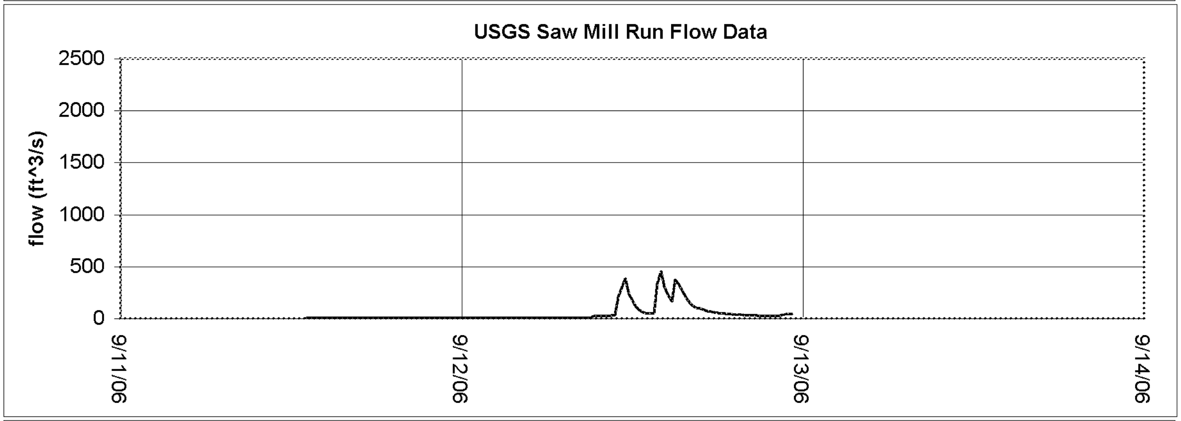

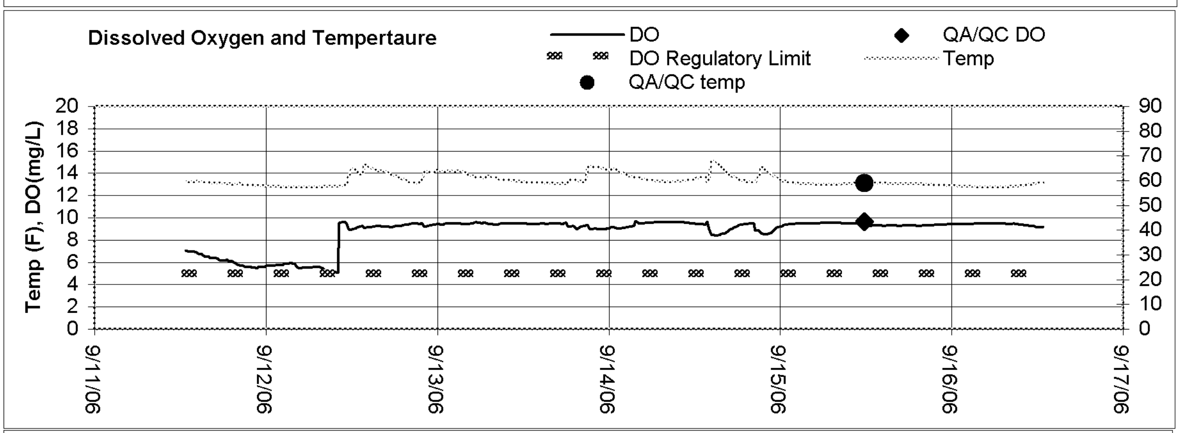

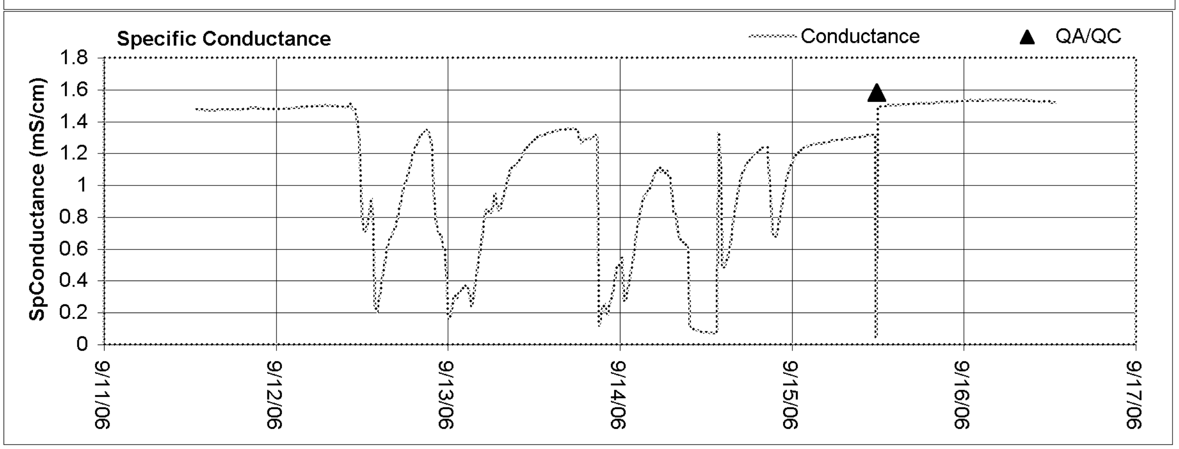

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WET WETHER DATA GRAPHS

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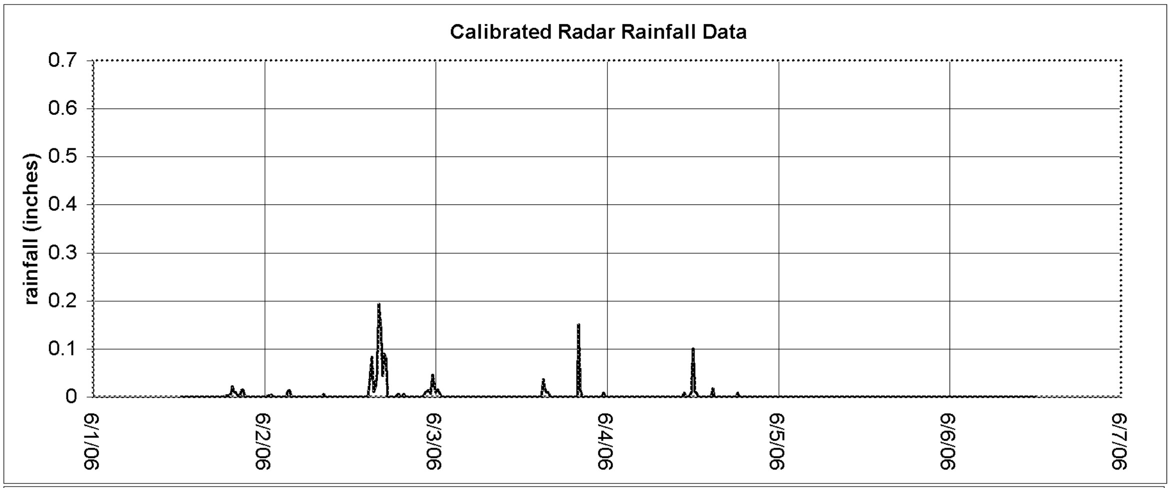

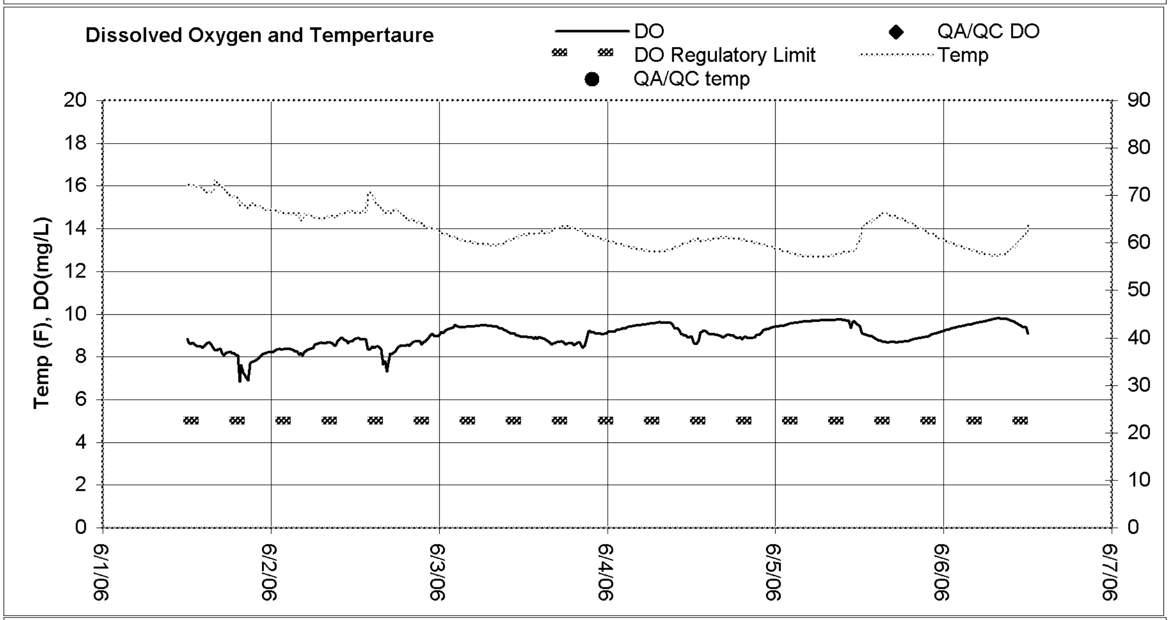

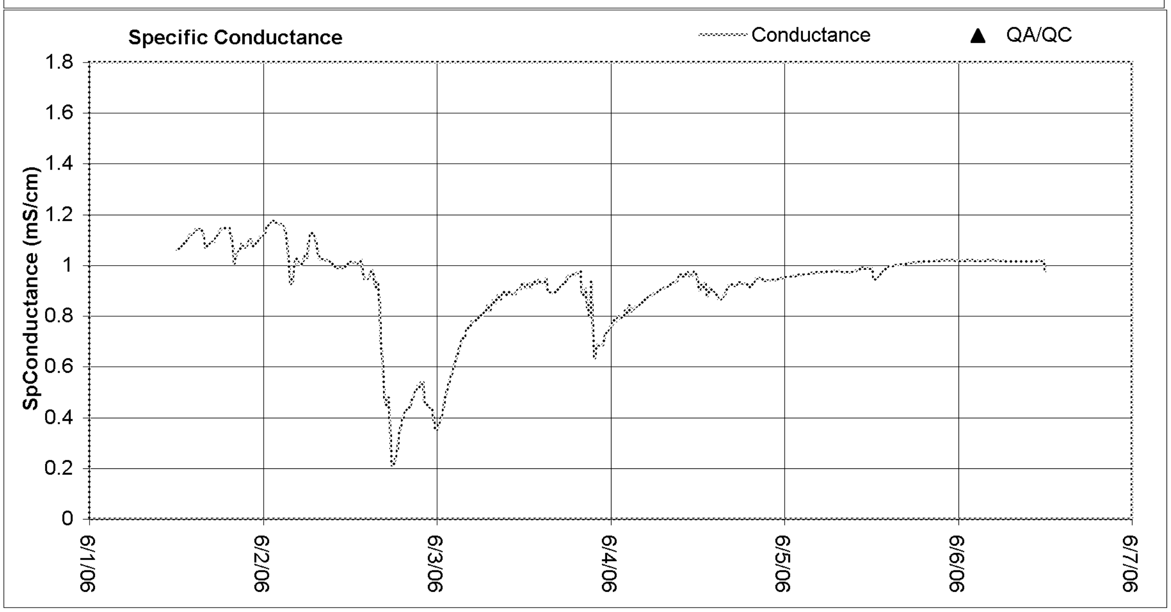

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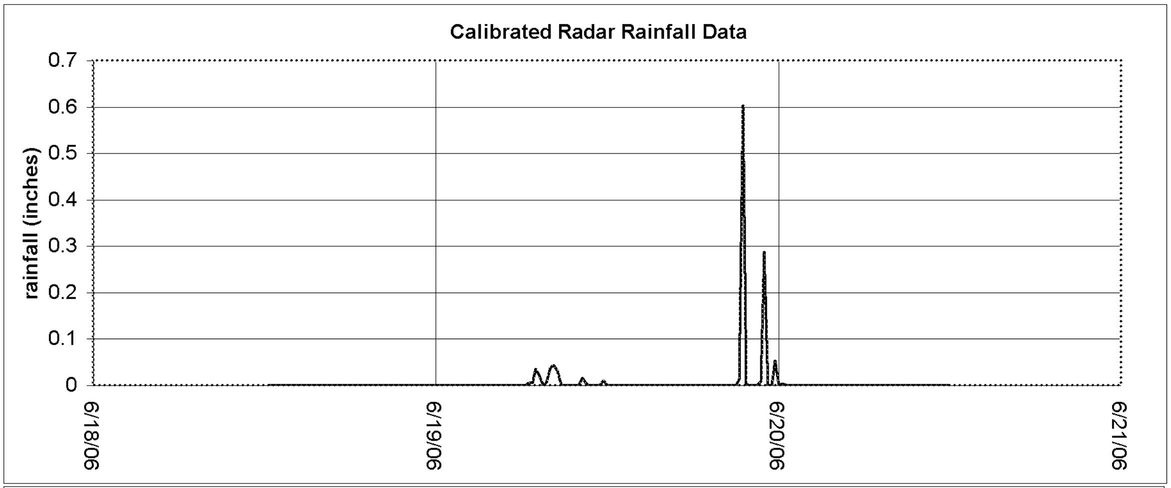

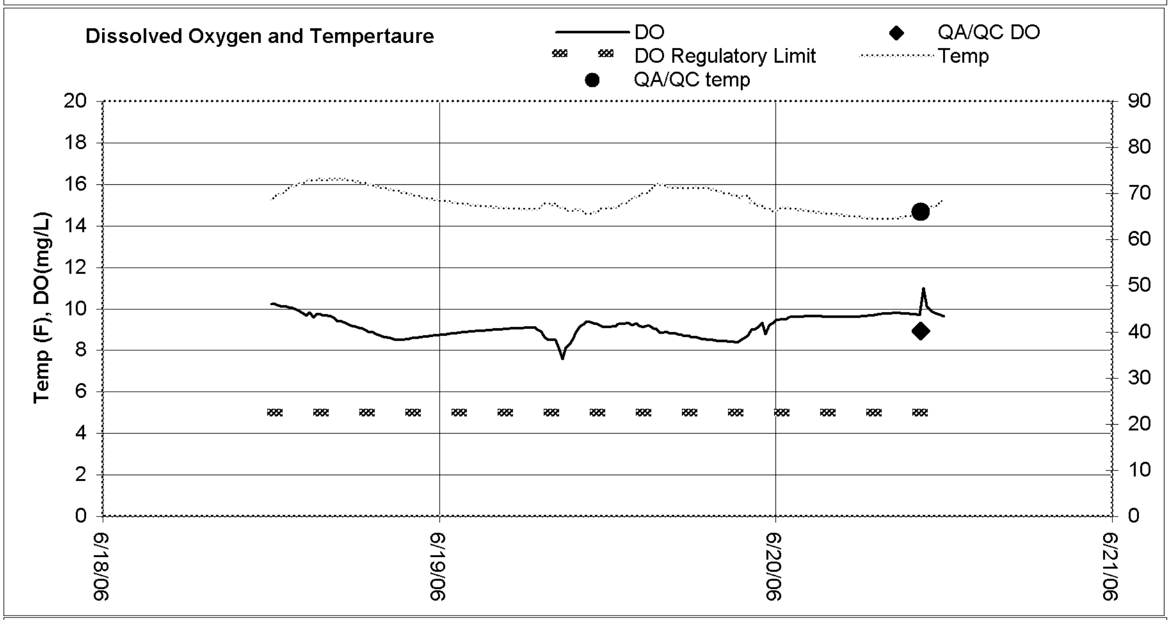

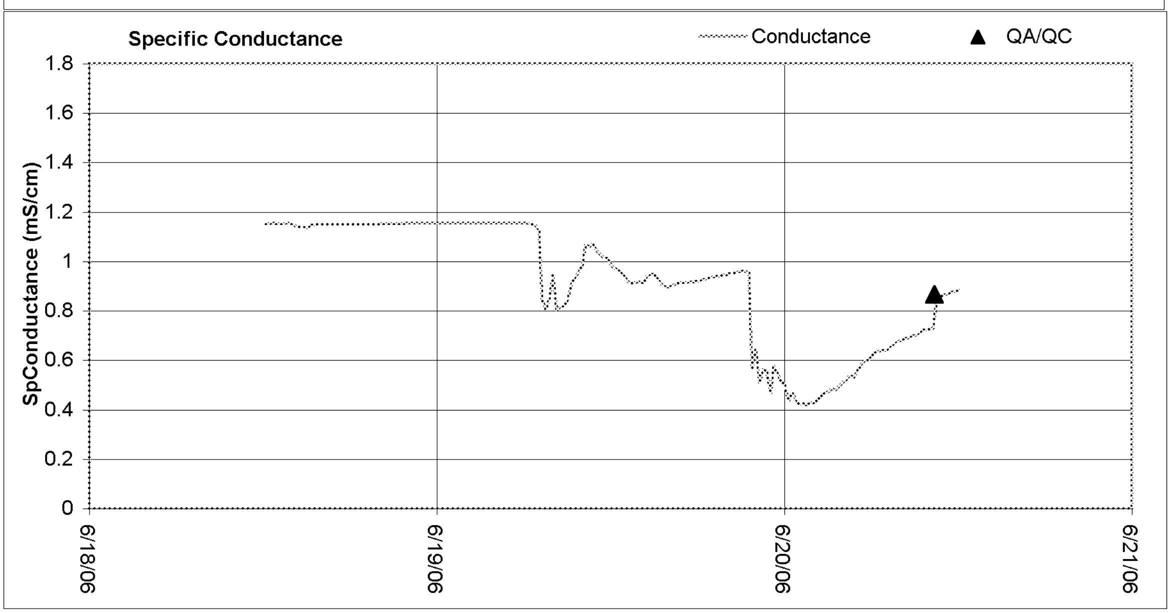

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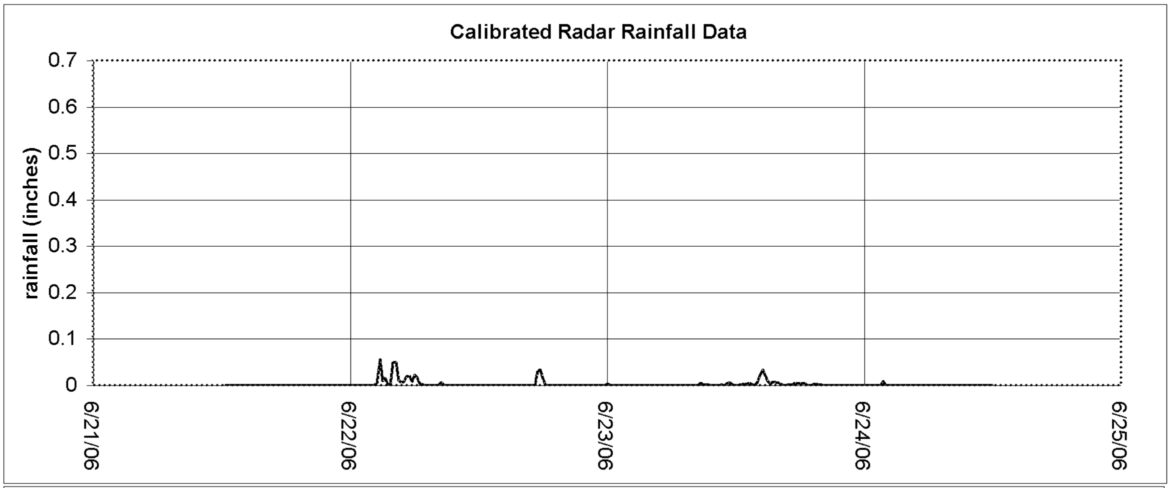

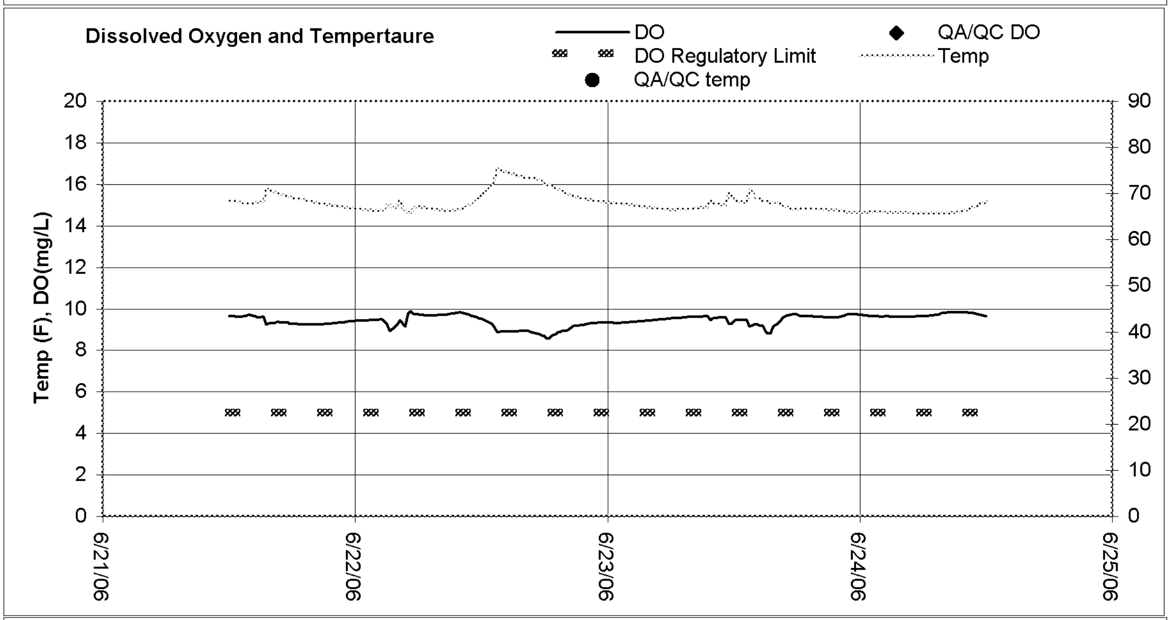

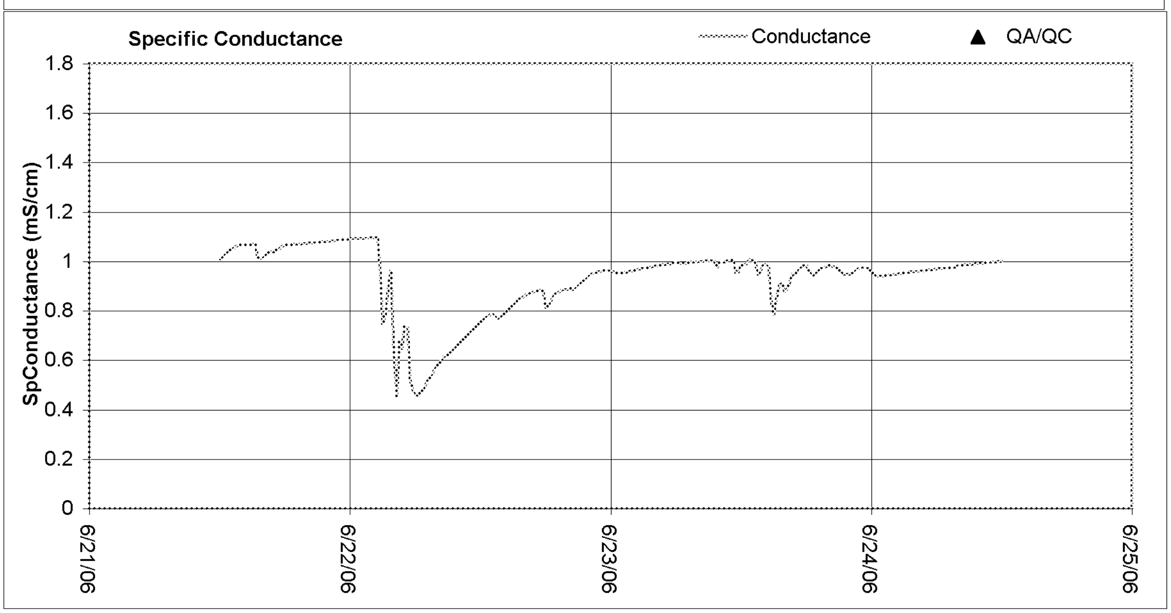

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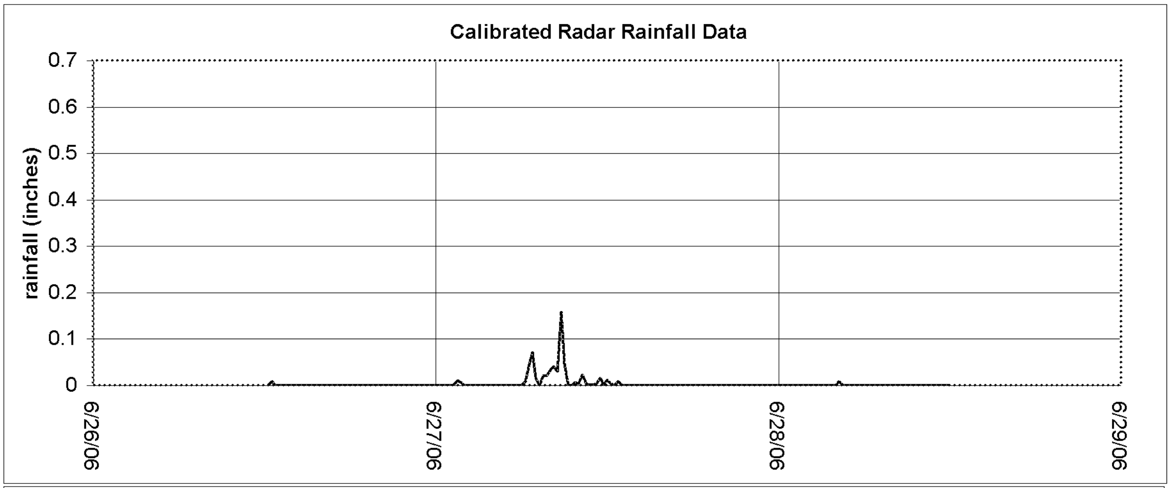

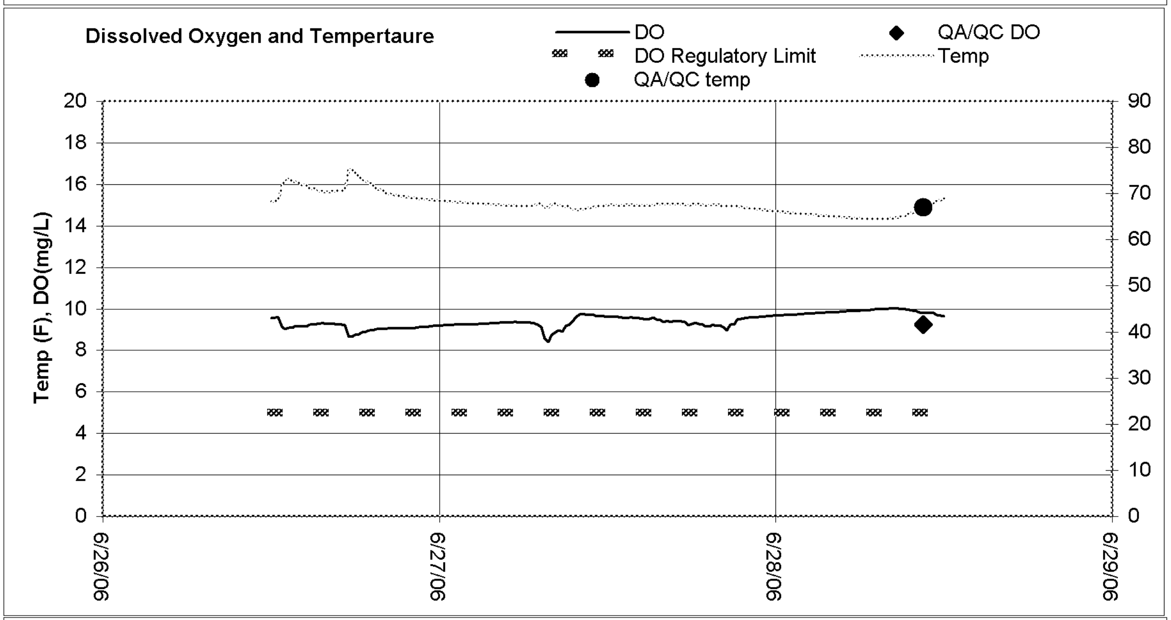

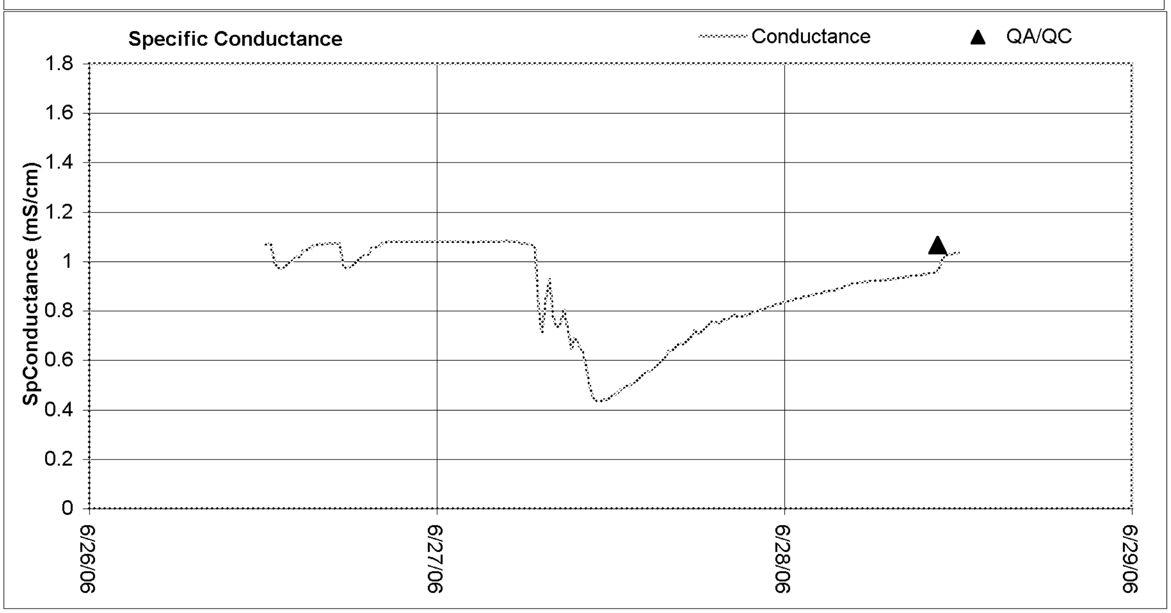

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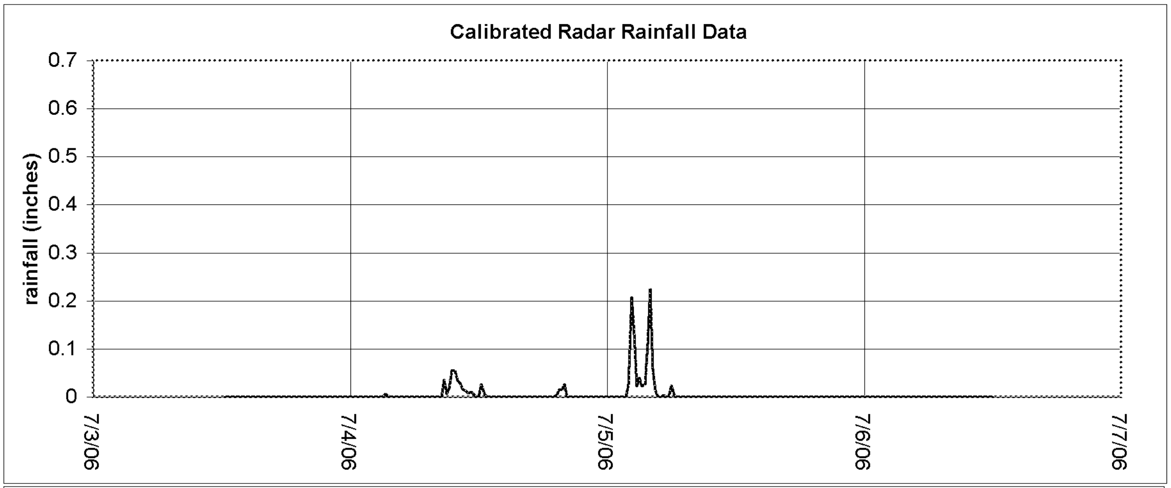

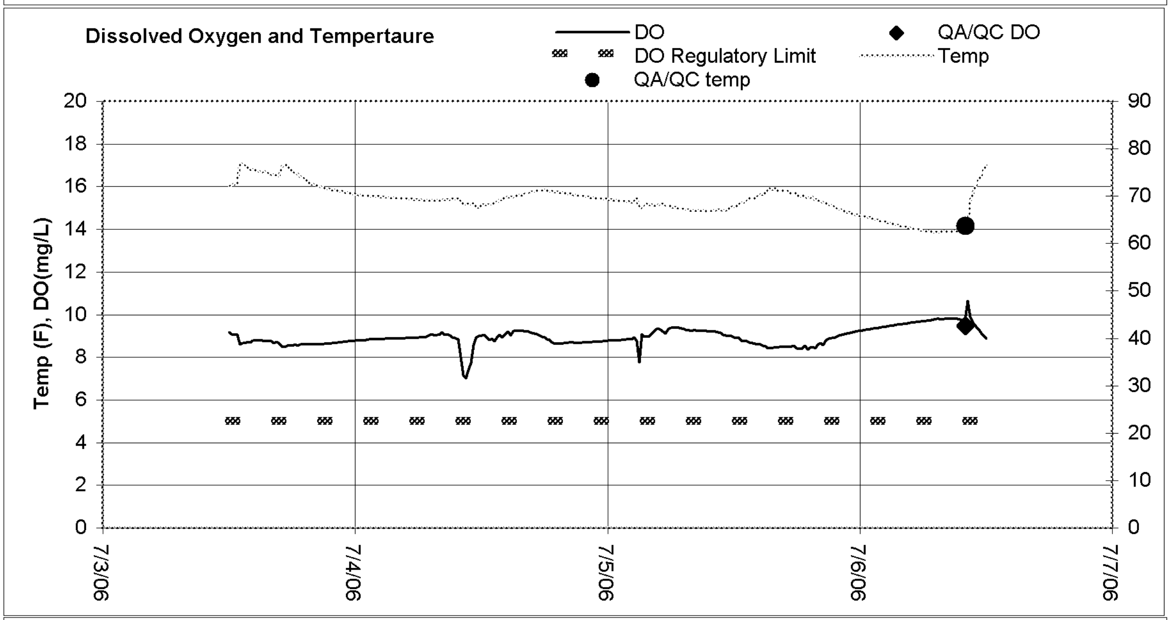

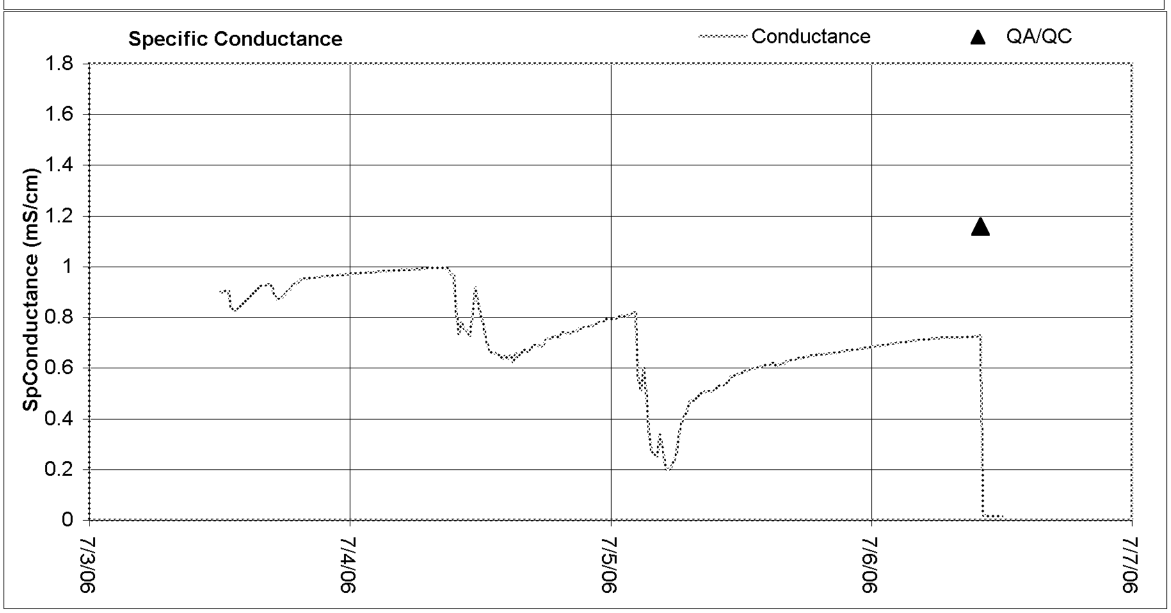

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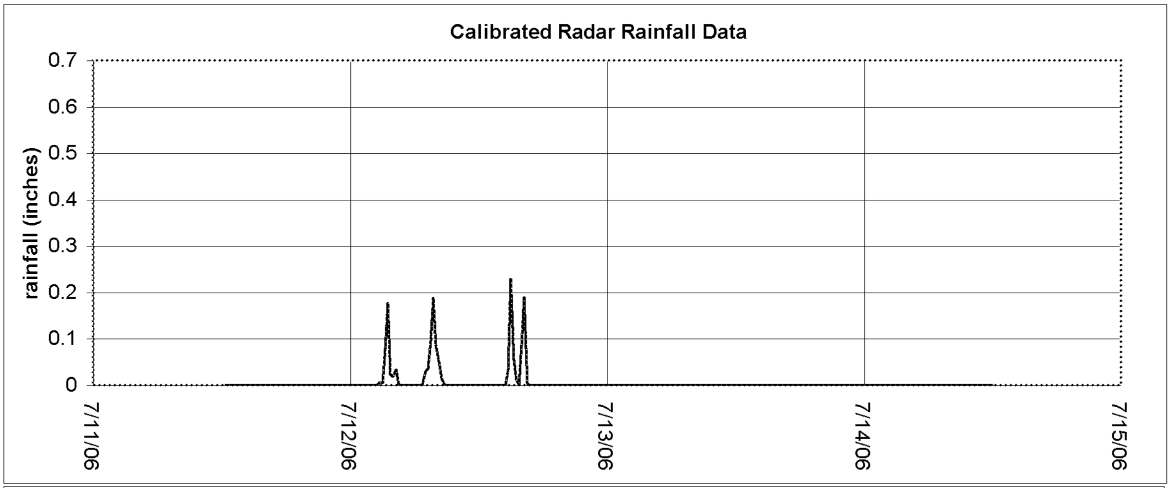

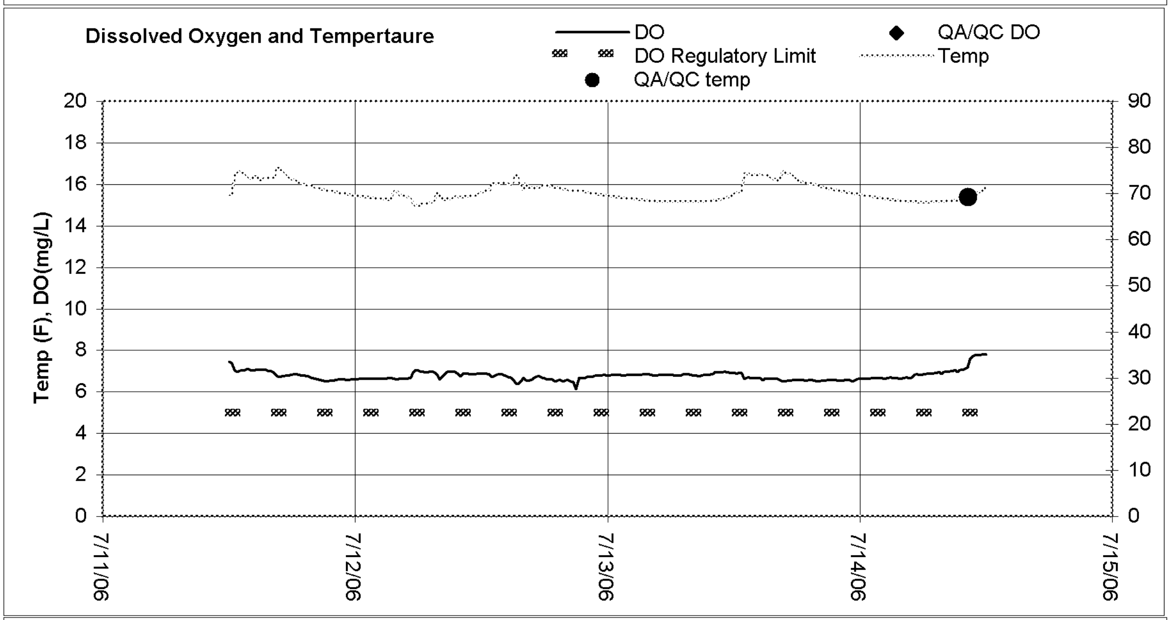

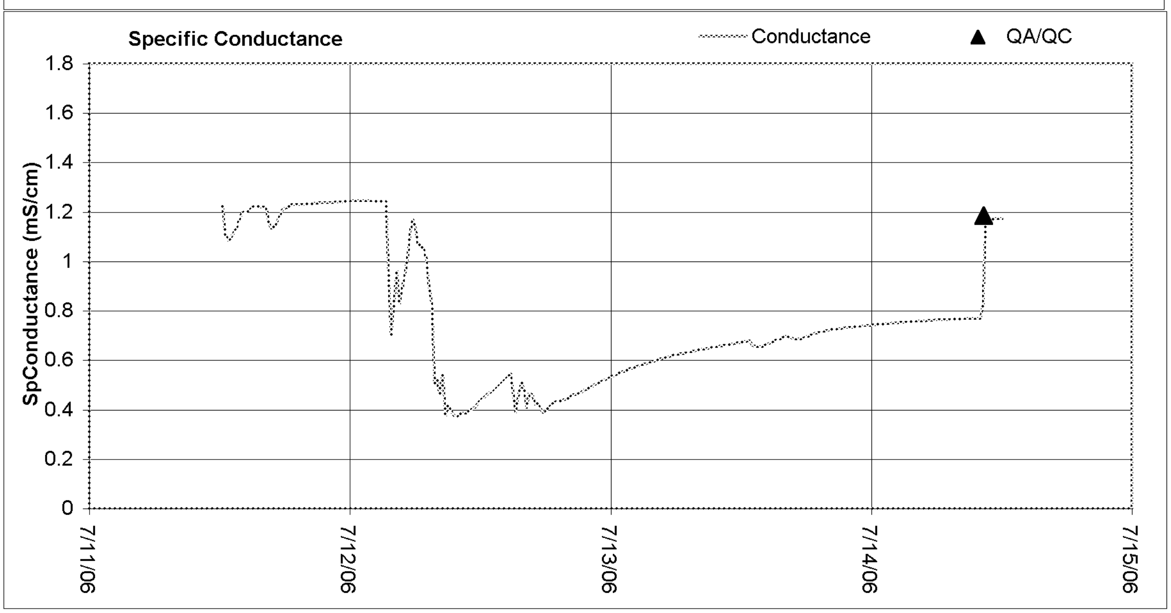

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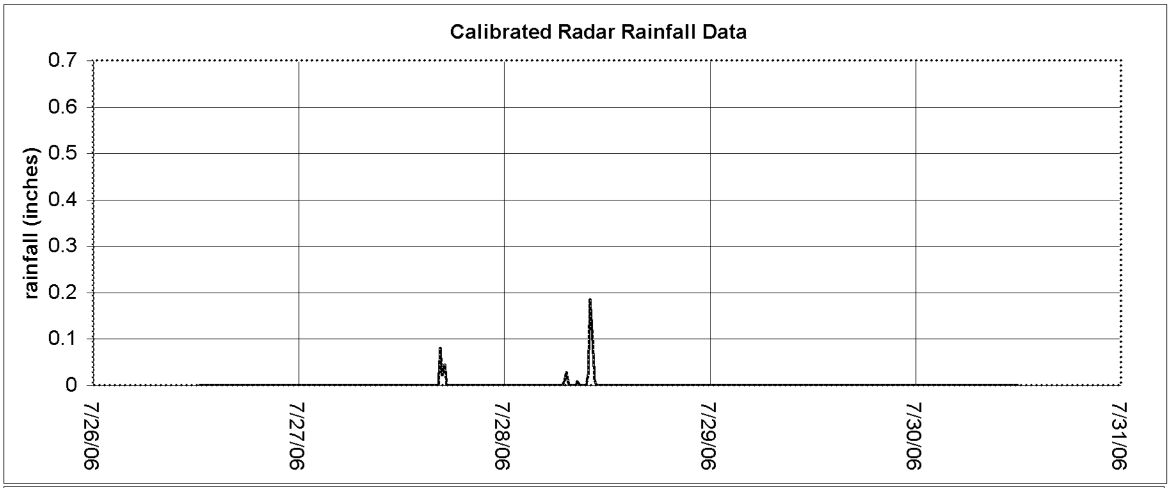

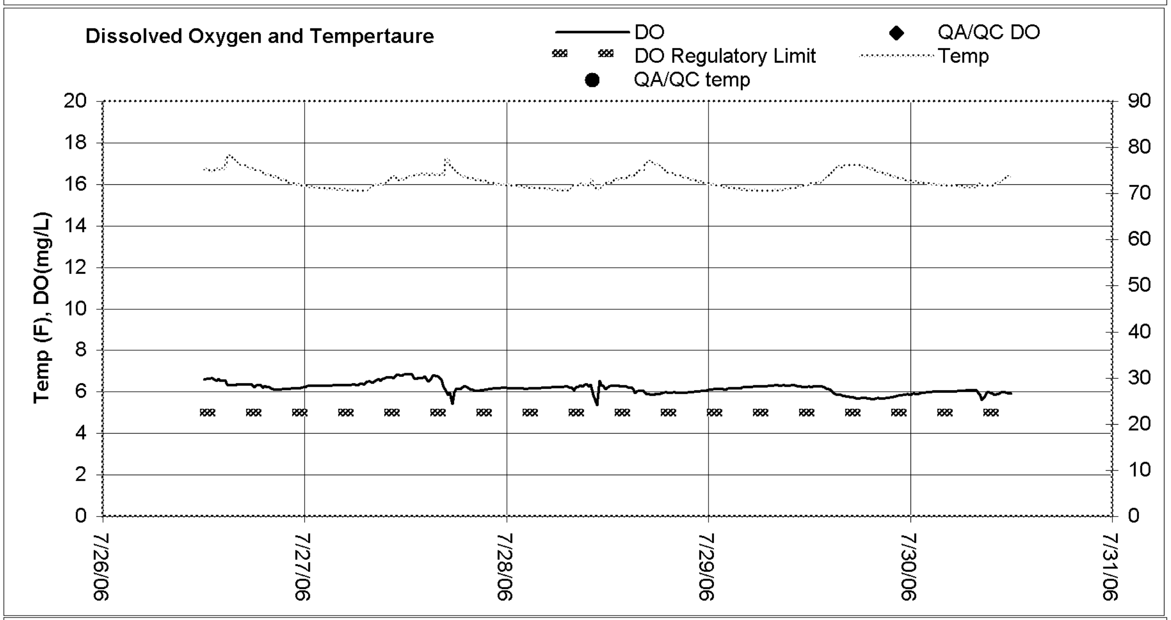

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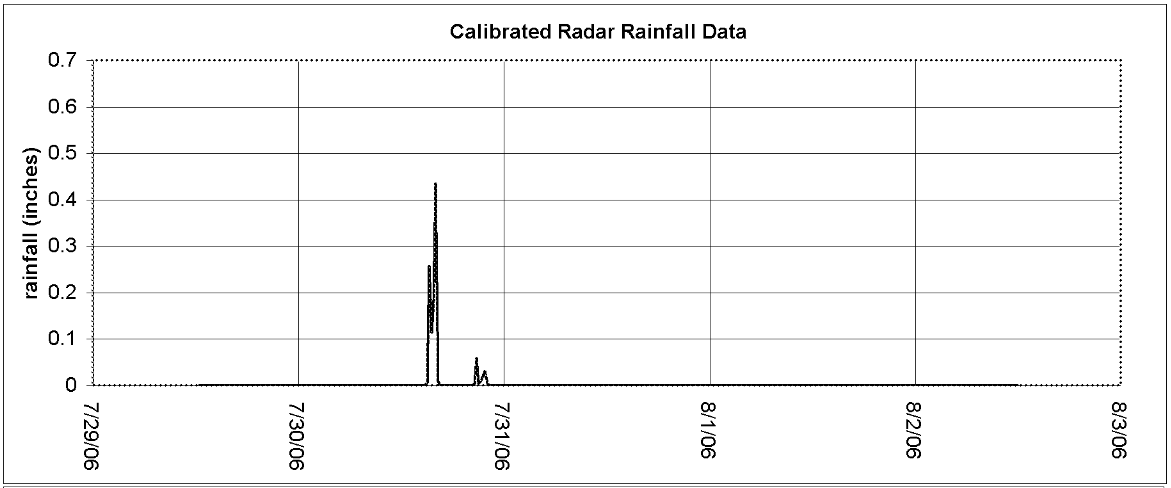

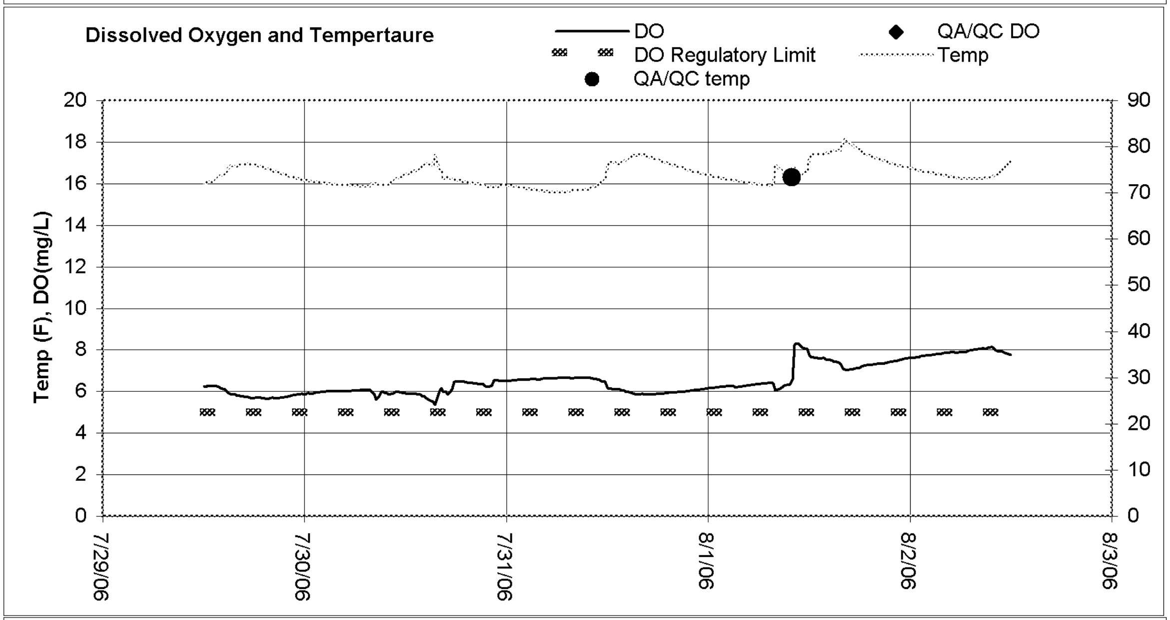

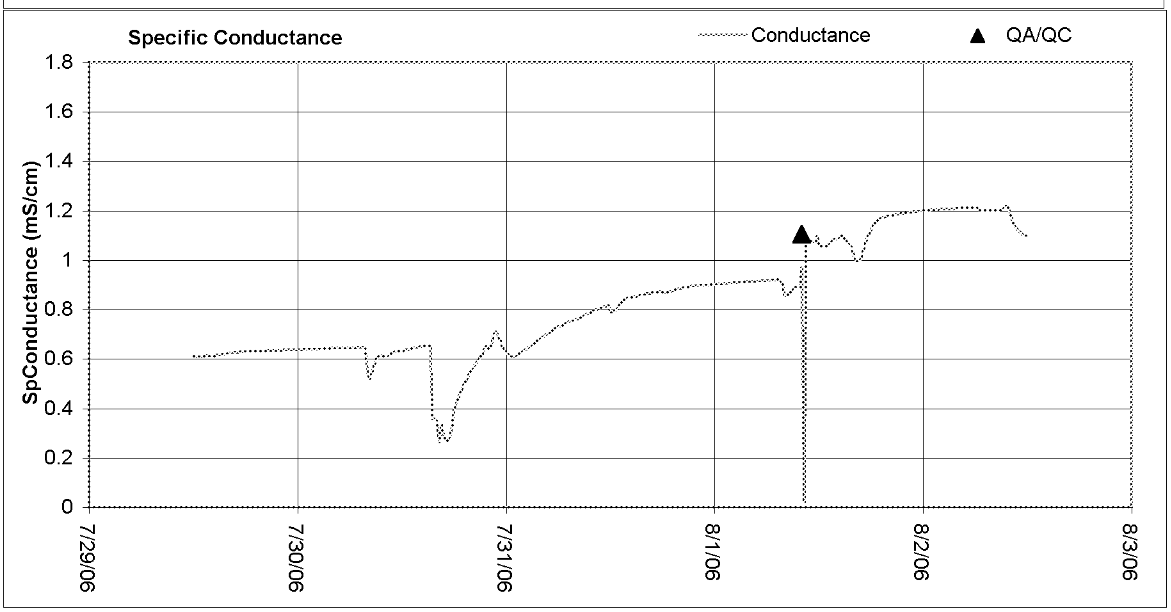

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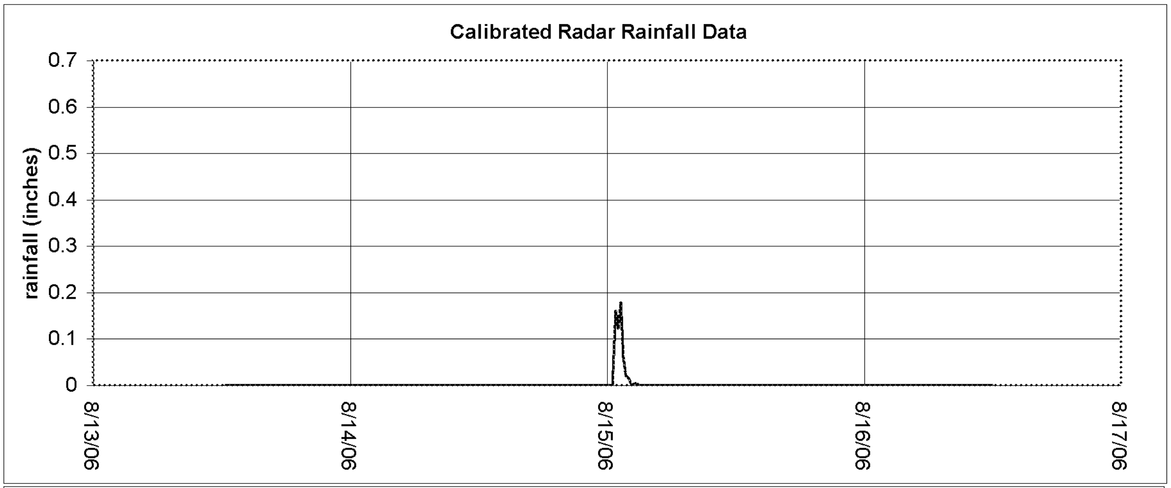

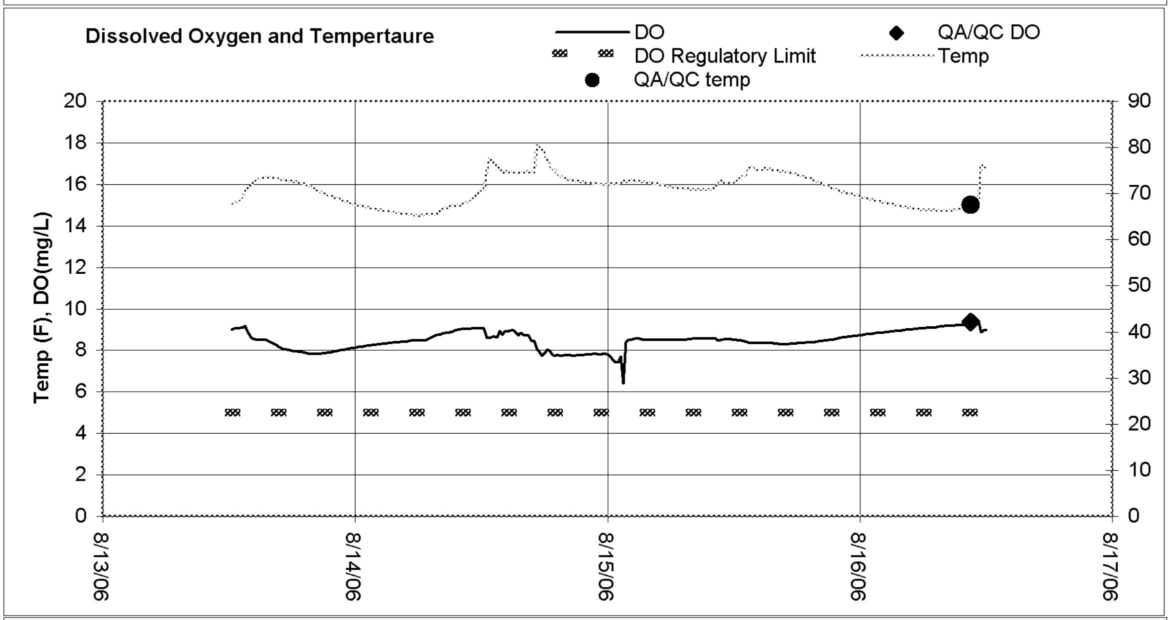

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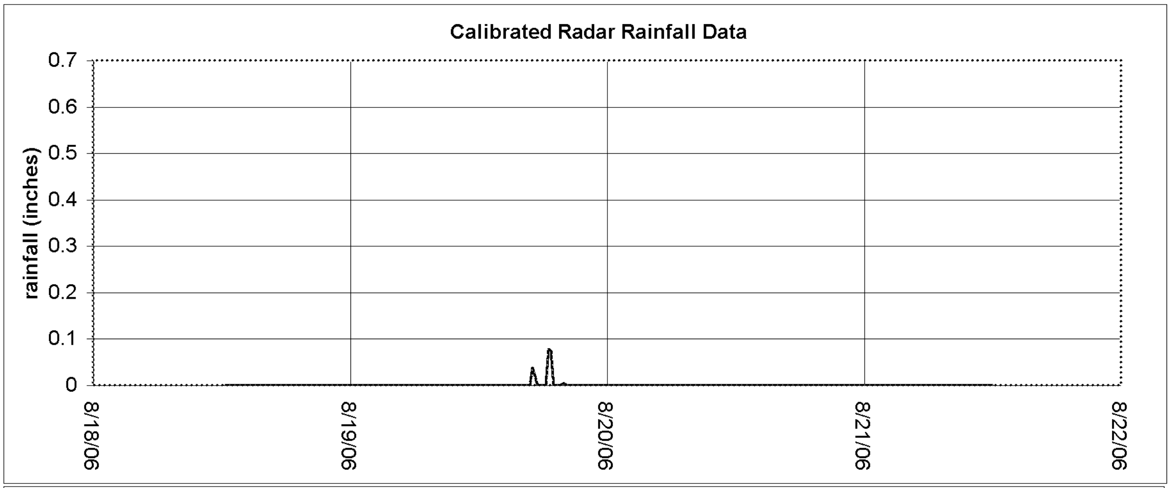

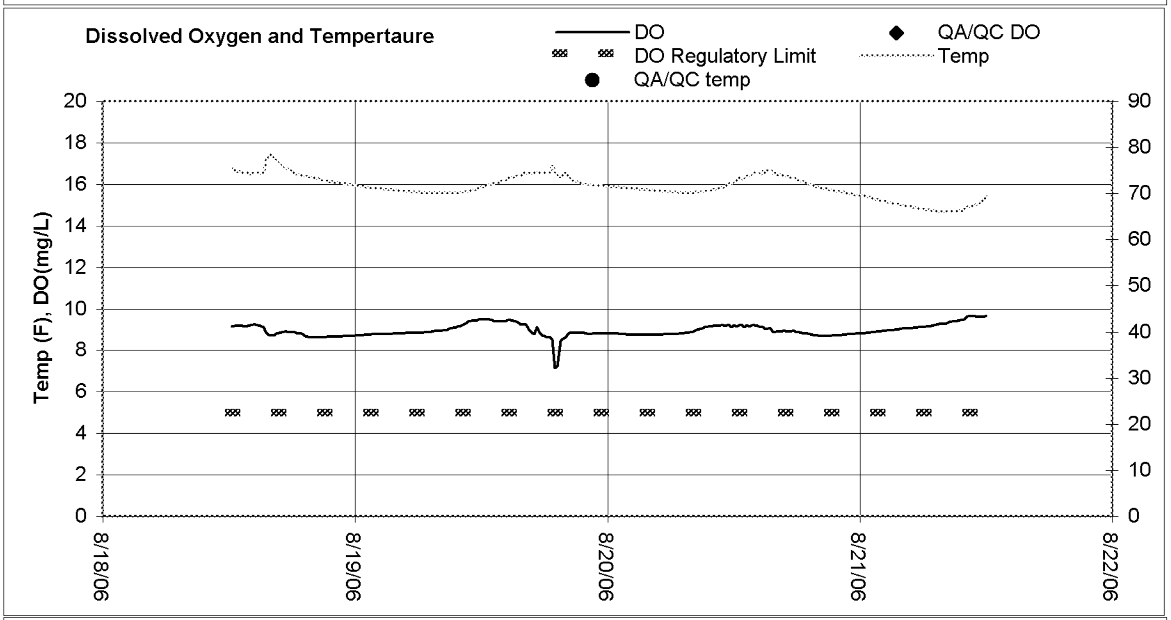

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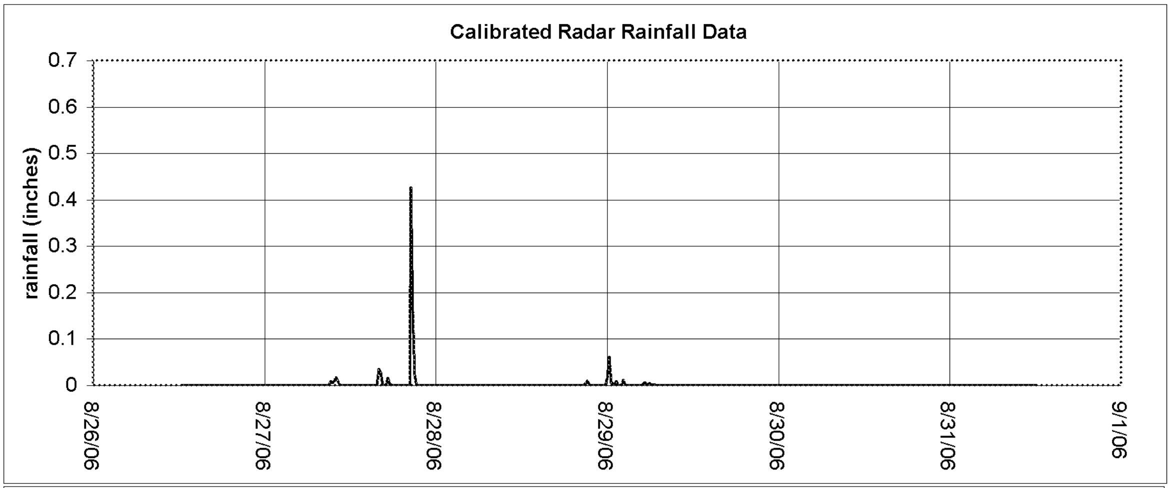

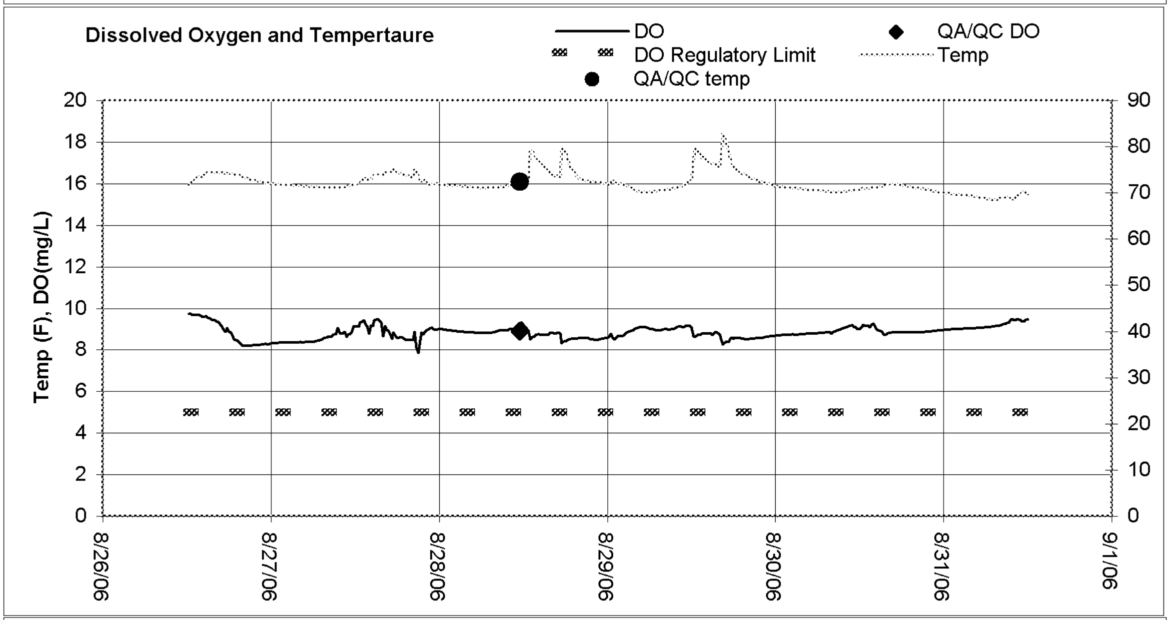

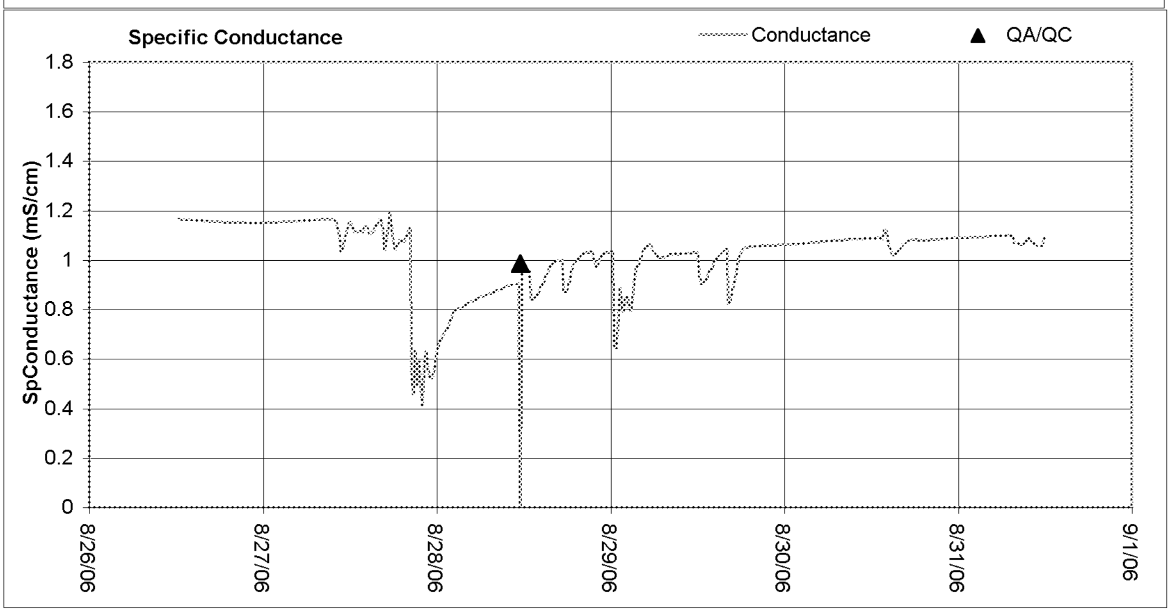

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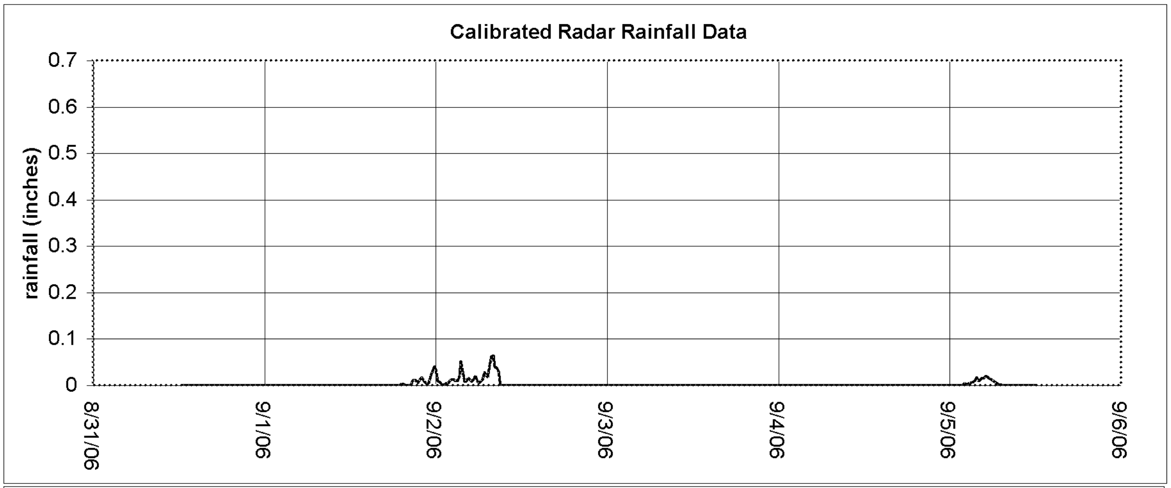

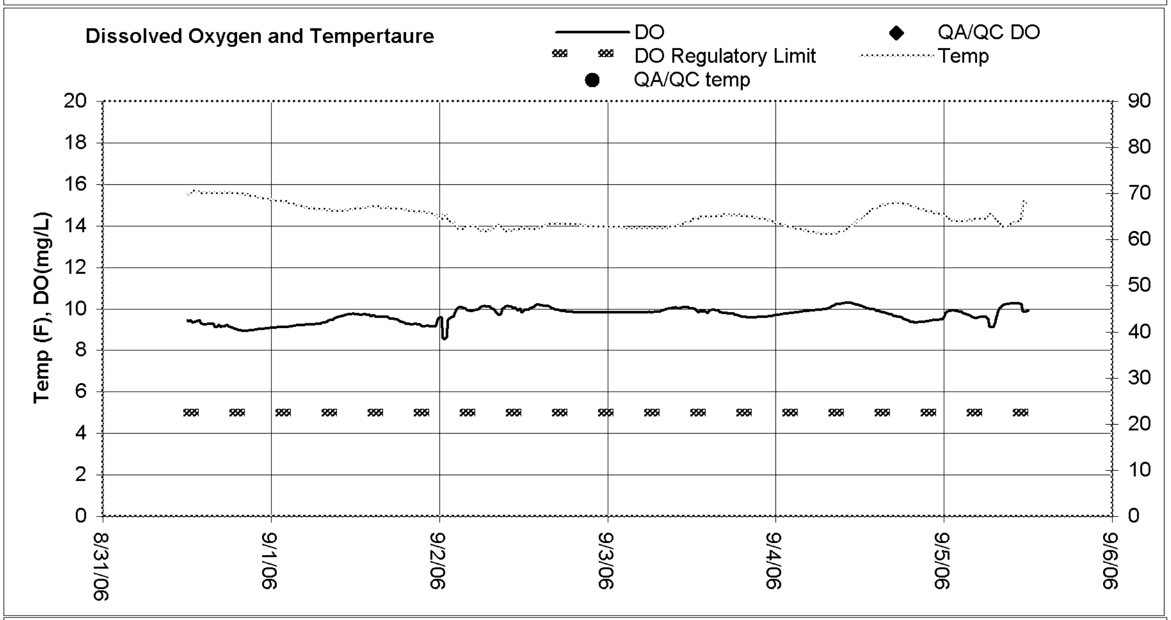

Partnering to achieve long term benefits

PWSA CSO Team

Metcalf & Eddy Baker/Wade-Trim

TECHNICAL PARAMETERS FOR CSO ALTERNATIVES ANALYSIS

Technical Memorandum

Submitted to:

PWSA

April 2007

PITTSBURGH WATER AND SEWER AUTHORITY
LTCP PROJECT FOR THE ABATEMENT OF CSO'S

TECHNICAL PARAMETERS FOR CSO ALTERNATIVES ANALYSIS TECHNICAL MEMORANDUM

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TECHNICAL PARAMETERS FOR CSO ALTERNATIVES ANALYSIS TECHNICAL MEMORANDUM

INTRODUCTION

The main objective of this memorandum is to provide a standardized set of information and data to be used for CSO Control Alternative Development and Evaluation. This standard set of information and data addresses a variety of issues such as pollutants of concern, control technology design parameters and CSO control levels.

CSO Control Drivers

There are a variety of drivers for CSO Control in Southwest Pennsylvania. Drivers specific to the PWSA service area include:

- Regulatory – CSOs must meet water quality standards or measures must be undertaken to ensure that CSO discharges do not result in non-attainment of water quality standards. This has been translated into NPDES Permit requirements.
- Consent Order Agreement – requires PWSA to develop a feasibility study describing how to handle CSOs that cannot be delivered to PWSA's connection point with the ALCOSAN interceptor system.
- "Z" Agreements – Paraphrased, these agreements state that ALCOSAN will handle all flows delivered to the connection point.
- Joint responsibility for most of the CSO outfalls that include flows from PWSA.
- PWSA does not have any satellite treatment or storage facilities in its sewer system; however, they do accept flows from 24 communities outside of the city boundaries.

General Assumptions

This segment addresses general assumptions that are applicable to the alternative development, evaluation and section process.

- A 20-year planning horizon will be used. In specific cases, the planning horizon may be extended to 50 years.
- Population forecasts by Southwest Pennsylvania Regional Planning Commission, or other applicable agency, will be used to establish planning year population. It is suggested that **2008** be used as the baseline year and **2028** as the planning year. If the baseline and planning years mandated in ALCOSAN's pending Consent Decree differ, the ALCOSAN dates may be utilized.
- Planning costs will be based on **2008** as the planning year.
- **2005** will be used as typical year for hydraulic simulations.
- Capital, O&M and land costs will be utilized during the evaluation of alternatives; the derivation of these costs are detailed in Basis of Cost for CSO Control Technologies Technical Memorandum.

Wastewater Treatment Plant

The following information describes the typical operating conditions at the ALCOSAN WWTP.

- Existing Primary Treatment Capacity is 225 MGD.
- Maximum Permitted Secondary Treatment Capacity is 200 MGD.
- Permitted Effluent Concentrations (daily average) are as follows.
  - TSS – 30 mg/L and 85% removal
  - BOD - 85% removal
  - $cBOD_5$ (May – Oct) – 20 mg/L
  - $cBOD_5$ (Nov – Apr) – 25 mg/L
  - Ammonia-N (May – Oct) – 15 mg/L

- Ammonia-N (Nov – Apr) – 25 mg/L
- Dissolved Oxygen – 5 mg/L
- pH – 6 to 9

PWSA Collection System

The following information describes local conditions having a direct correlation to the performance of the PWSA collection and conveyance system.

- Average annual rainfall is 38 inches.
- Typical Year - 2005
- Design storms – Hydraulic capacity evaluations will be based on a series of design storms outlined in the Rainfall Analysis, Update 2, Metcalf & Eddy, 2007.

Based upon the arithmetic means of field sampling results from sampling undertaken during the summer of 2006, the following concentrations of pollutants are anticipated to be present in "typical" PWSA CSOs.

- TSS – 75 mg/L
- BOD – 27 mg/L
- Fecal Coliform – 2.8 x 10^6 colony forming units per 100 ml sample

CSO Control Levels

The required level of CSO control to be achieved for a given CSO discharge differs depending upon whether the demonstration or presumptive method of measuring control effectiveness is used. Using the demonstration method, the level of control differs depending upon whether the discharge is to a main river or to a tributary stream. CSO discharges to the Allegheny, Monongahela or Ohio rivers may require a lesser level of control than those discharges to tributary streams. These control levels are summarized below. Control language based on national CSO policy. A separate memorandum detailing the control levels in under development.

TABLE 1. CSO CONTROL LEVELS

METHOD	MAIN RIVERS	TRIBUTARY STREAMS
Demonstration	Allow 0, 1, 2, 4 & 6 CSOs per year	Allow 0, 1, 2, 4 & 6 CSOs per year
Presumptive	85% Capture of system flows	85% Capture of system flows

CSO CONTROL TECHNOLOGIES

Feasible Technologies

Numerous CSO control technologies were researched to determine their feasibility for inclusion in CSO control alternatives within the PWSA collection and conveyance system. These technologies are summarized in Appendix A. Technology Screening Results.

Technology Design Criteria

In order to evaluate the size and physical impacts of each CSO control alternative, planning level sizing design criteria were developed for each technology. The consistent application of these design criteria generated information useful to the detailed evaluation of each alternative's Constructability Impact. In addition typical process flow schematics have been included for "generic" storage alternatives and "generic" treatment alternatives. The schematics illustrate the control elements that were included in the cost estimates for each alternative.

The cost estimation and sizing design criteria are summarized below:

<u>Source Control Technologies:</u>

- Sewer and manhole rehabilitation
  - Sizing basis: per linear foot of sewer
  - Design: PWSA standard

- Land requirements: Variable by site conditions and method of rehab

Collection System Control Technologies:

- Collection System Controls – Sewer System Optimization
  - Sizing basis: per linear foot of sewer
  - Design: PWSA standard
  - Land requirements: Variable by site conditions and construction route
- Collection System Controls – Regulator Optimization
  - Existing regulator modification: cost per device
  - New regulator device: cost per device
  - New regulating structure: cost per structure (automatic / static)
  - Land requirements: 10,000 SF / new regulator structure
- Relief Sewer
  - Sizing basis: per linear foot of sewer and flow conditions

    0 to 25 CFS = 36-in pipe

    25 to 50 CFS = 48-in pipe

    50 to 100 CFS = 66-in pipe

    100 to 150 CFS = 78-in pipe

    150 to 200 CFS = 90-in pipe

    200 to 250 CFS = 96-in pipe

    250 to 300 CFS = 108-in pipe

    >300 CFS = 120-in pipe

- Land requirements: Variable by site conditions and construction route
- Also required: Interceptor connections

- Sewer Separation:
  - Sizing basis – urban setting: per-acre
  - Sizing basis – suburban setting: per-acre
  - Land requirements: Variable by site conditions and construction route

<u>Storage Technologies:</u>

- In-line storage (all types):
  - Sizing basis: Peak volume
  - Available storage capacity: 80% of pipeline diameter
  - Minimum effective pipe size: 5-ft diameter
  - Maximum pipe slope: 2%
- Sub-surface storage (tunnels)
  - Sizing basis: Peak volume
  - Available storage capacity: 80% of tunnel volume
  - Minimum effective tunnel size: 7-ft diameter
  - Maximum effective tunnel size: 30-ft diameter
  - Number of drop shafts: Varies by tunnel route and site conditions
  - Dewatering pump station: Varies according to tunnel volume and dewatering time
  - Dewatering time, average: 24 hours at full capacity
  - Land requirements – Drop shafts: 150’x150’ per shaft

- Other land requirements: Dewatering pump station, odor control, screening and regulator facilities.
- Also required: Consolidation piping, odor control, screening, regulators and flushing system.

- Sub-surface storage (closed concrete tanks)
  - Sizing basis: Peak volume
  - Available storage capacity: 85% of tank volume
  - Minimum effective tank volume: 1 MGal
  - Maximum side-water depth: 15-ft
  - Dewatering pump station: Varies according to tank volume and dewatering time
  - Dewatering time, average: 24 hours @ full capacity
  - Land requirements – Storage Tank: 3 x tank area
  - Other land requirements: Dewatering pump station, odor control, screening and regulator facilities.
  - Also required: Consolidation piping, odor control, screening and regulators.
  - Tank flushing system included in tank cost

- Surface storage (all types)
  - Sizing basis: Peak volume
  - Available storage capacity: 85% of tank volume
  - Minimum effective tank volume: 1 MGal
  - Maximum side-water depth: 15-ft
  - Dewatering pump station: Varies according to tank volume and dewatering time

- Dewatering time, average: 24 hours @ full capacity
- Land requirements – Storage Tank: 3 x tank area
- Other land requirements: Dewatering pump station, odor control, screening and regulator facilities.
- Also required: Consolidation piping, odor control, screening and regulators.
- Tank flushing system included in the tank cost.

<u>Treatment Technologies:</u>

- Suspended solids control (High Rate Sedimentation - Vortex)
    - Sizing basis: Peak flow rate
    - Hydraulic loading rate: 10,000 gpd/sf
    - Underflow rate: 10% of influent flow
    - Maximum diameter: 35-ft
    - Pumping station: Capacity = Influent + underflow
    - Land requirements: 3 x facility footprint
    - Other land requirements: Dewatering pump station, odor control, screening, disinfection and regulator facilities.
    - Also required: Consolidation piping, odor control, screening, disinfection and regulators.
    - Note: a pilot study may be recommended by engineer / manufacturer.
- High rate end of pipe (ballasted floc)
    - Sizing basis: Peak flow rate
    - Hydraulic loading rate: 85,000 gpd/sf (sedimentation)
    - Underflow rate: 10% of influent flow
    - Pumping station: Capacity = Influent + underflow

    - Land requirements: 3 x facility footprint
    - Other land requirements: Dewatering pump station, odor control, screening, disinfection and regulator facilities.
    - Also required: Consolidation piping, odor control, screening, disinfection and regulators.

- CSO Treatment Facility (storage / sedimentation and detention and treatment)
    - Sizing basis: Peak flow rate
    - Hydraulic loading rate, average: 4,500 gpd/sf
    - Hydraulic loading rate, maximum: 6,000 gpd/sf
    - Maximum side-water depth: 12-ft
    - Maximum length to width ratio: 3:1
    - Dewatering time, average: 24 hours
    - Detention time, average: 15 minutes
    - Available capacity: 80% of basin volume
    - Land requirements: 3 x facility footprint
    - Other land requirements: Dewatering pump station, odor control, screening, disinfection and regulator facilities.
    - Also required: Consolidation piping, odor control, screening, disinfection and regulators.

- Floatable and coarse solids control (screens, in-line netting, underflow baffles)
    - Sizing basis: Peak flow rate
    - Flow velocity in channel: 3 fps
    - Land requirements: 1000 sf / mgd flow
    - Also required: Disinfection.

- Disinfection (sodium hypochlorite)

- Sizing basis: Peak flow rate
- Average detention time: 10 minutes
- Minimum detention time: 5 minutes
- Average dose: 15 mg/L
- CT for 4-log reduction of fecal: 100 to 150
- Land requirements: 1000 sf / mgd flow
- Also required: Assume dechlorination of all treatment alternatives, wherever chlorine related products are used for disinfection.

- Disinfection (all others)
  - For planning purposes, utilize sodium hypochlorite design criteria.
- Sidestream elevated pool aeration
  - Weir loadings: 2.5 cfs/foot
  - Weir drop: 3 to 5 feet

CSO CONTROL ALTERNATIVES

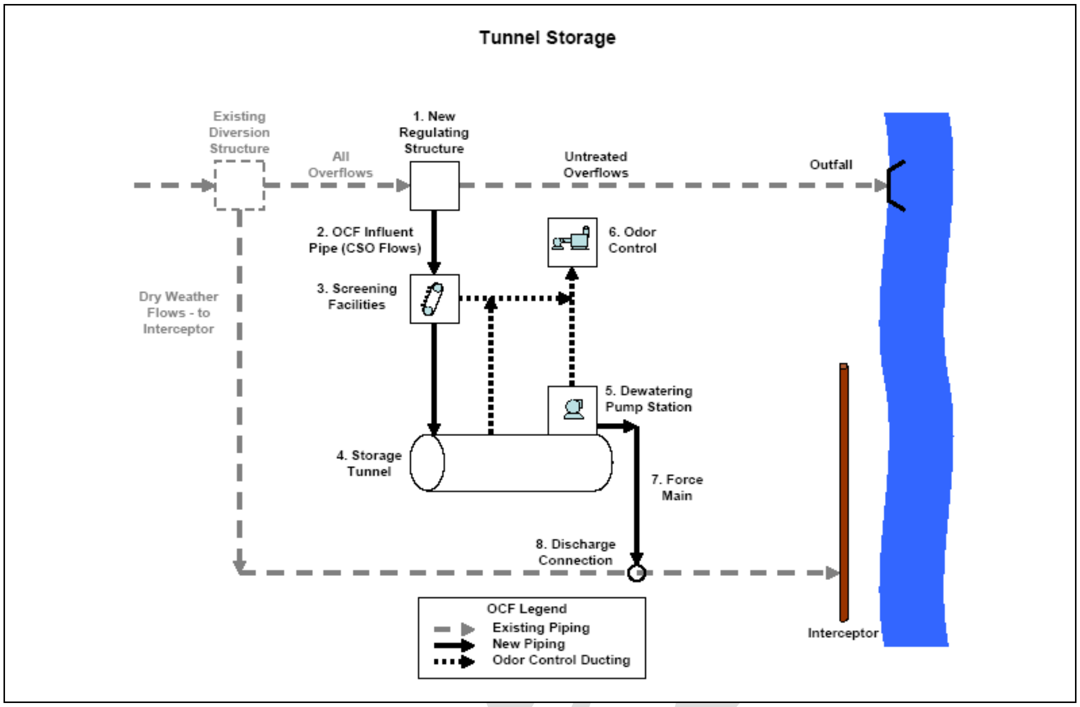
Typical Process Diagrams

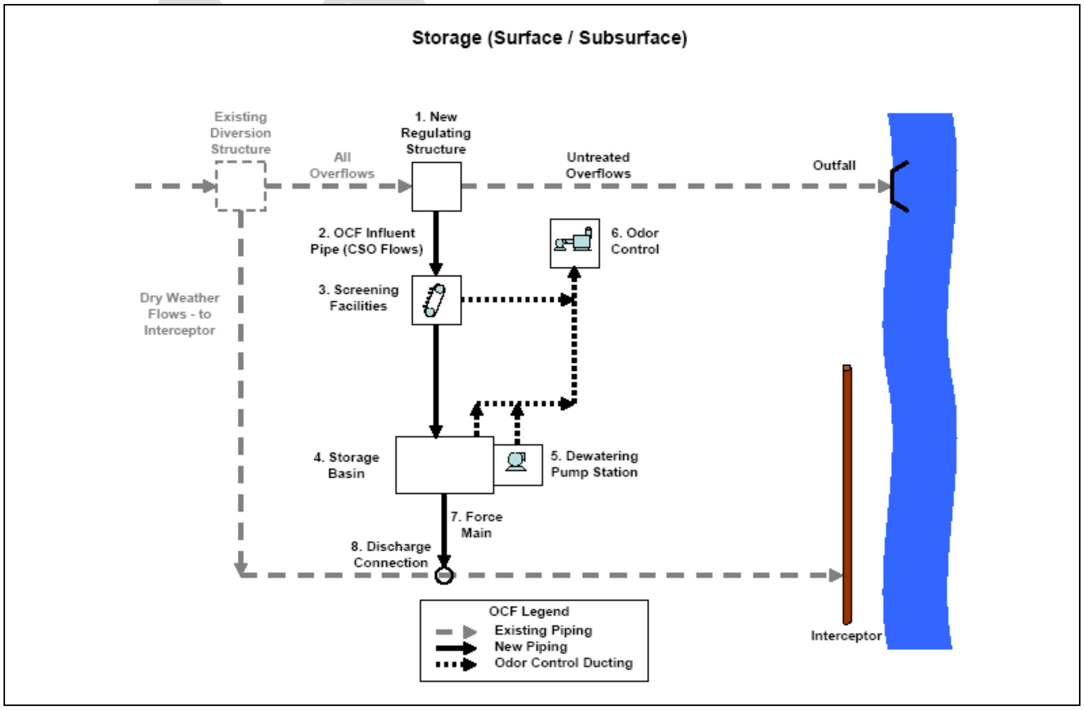
The CSO control technologies that were determined to be feasible for inclusion in CSO control alternatives can be configured in a variety of ways, based upon the needs of each specific CSO location. However, the variety of configurations can be grouped into the following typical process categories:

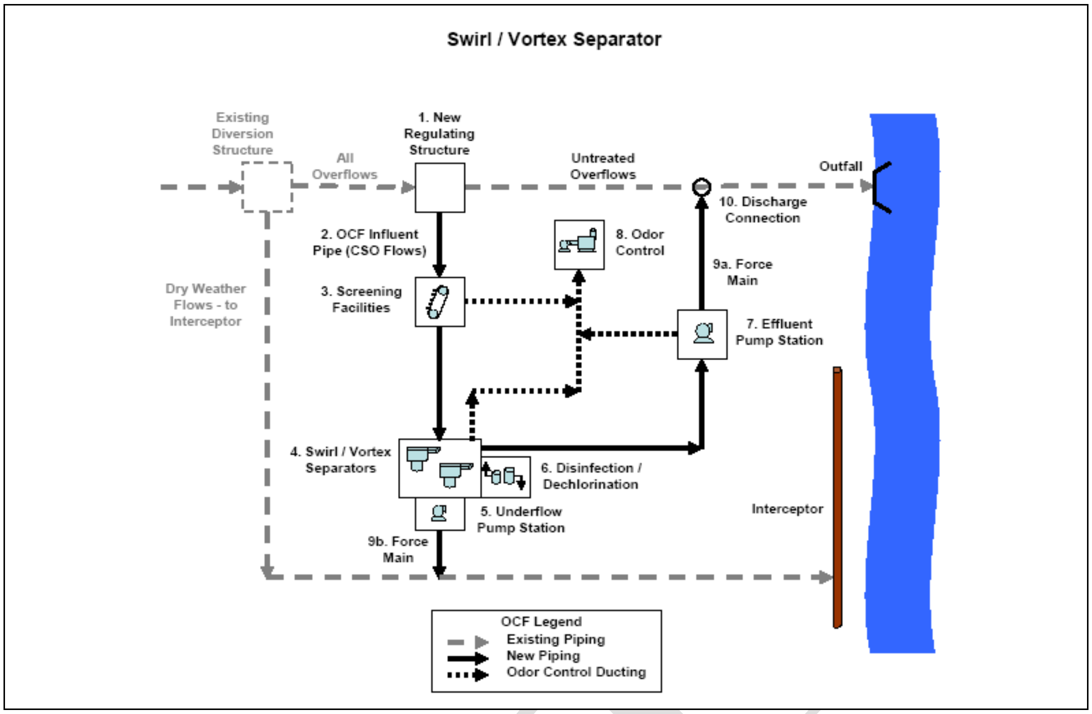
- Tunnel Storage Alternatives
- Surface / Subsurface Storage Alternatives
- Swirl / Vortex Separator Alternatives
- Detention / Treatment Alternatives

- High Rate Treatment Alternatives
- Screening & Disinfection Alternatives

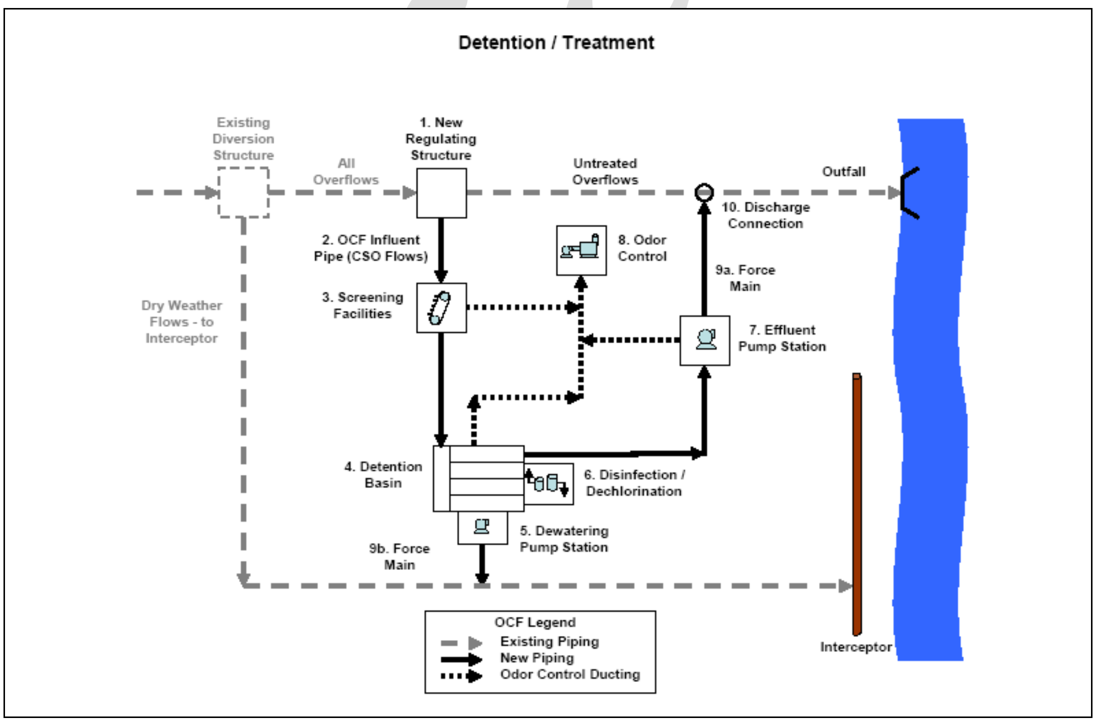
Diagrams representing each of these typical processes are included below in Figures 1 through 6.


Tunnel Storage
Existing Diversion Structure
All Overflows
1. New Regulating Structure
Untreated Overflows
Outfall
2. OCF Influent Pipe (CSO Flows)
6. Odor Control
Dry Weather Flows - to Interceptor
3. Screening Facilities
5. Dewatering Pump Station
4. Storage Tunnel
7. Force Main
8. Discharge Connection
OCF Legend
Existing Piping
New Piping
Odor Control Ducting
Interceptor

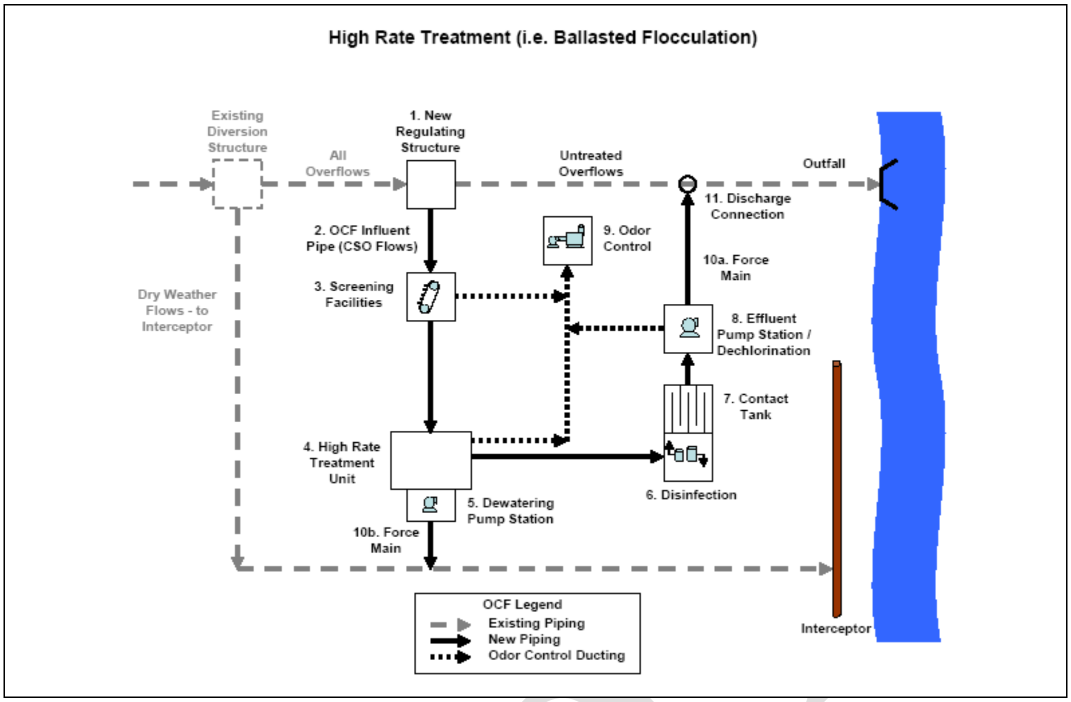

Storage (Surface / Subsurface)
Existing Diversion Structure
All Overflows
1. New Regulating Structure
Untreated Overflows
Outfall
2. OCF Influent Pipe (CSO Flows)
6. Odor Control
Dry Weather Flows - to Interceptor
3. Screening Facilities
4. Storage Basin
5. Dewatering Pump Station
7. Force Main
8. Discharge Connection
OCF Legend
Existing Piping
New Piping
Odor Control Ducting
Interceptor

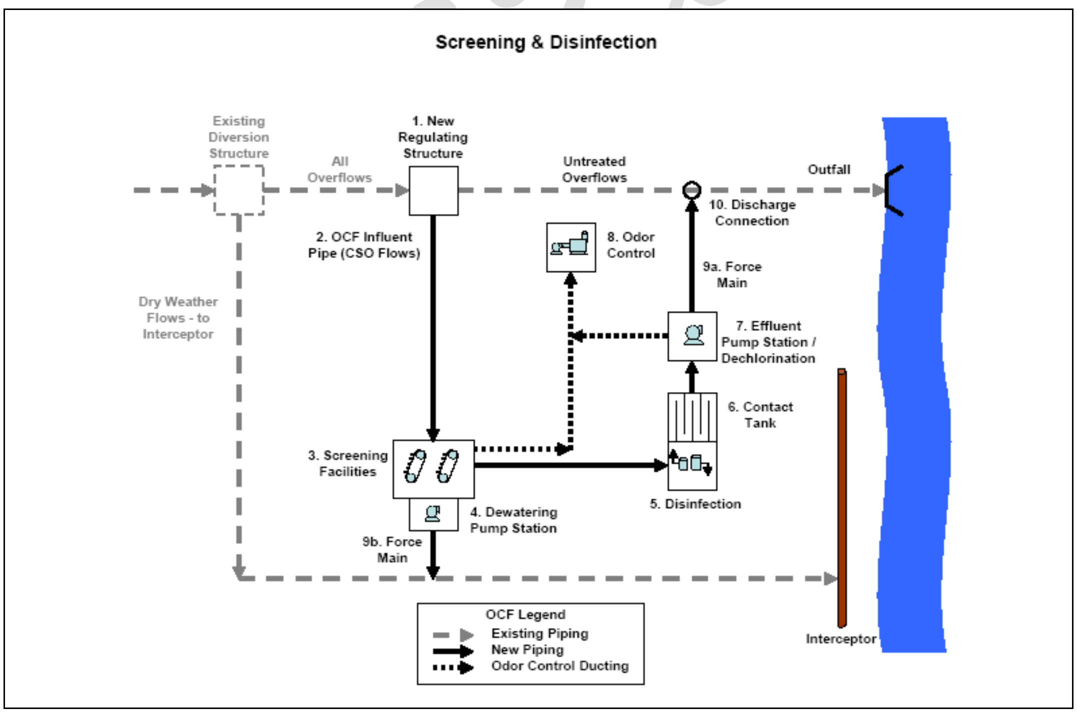


Swirl / Vortex Separator
Existing Diversion Structure
1. New Regulating Structure
All Overflows
Untreated Overflows
Outfall
10. Discharge Connection
2. OCF Influent Pipe (CSO Flows)
8. Odor Control
9a. Force Main
Dry Weather Flows - to Interceptor
3. Screening Facilities
7. Effluent Pump Station
4. Swirl / Vortex Separators
6. Disinfection / Dechlorination
5. Underflow Pump Station
Interceptor
9b. Force Main
OCF Legend
Existing Piping
New Piping
Odor Control Ducting



Detention / Treatment
Existing Diversion Structure
1. New Regulating Structure
All Overflows
Untreated Overflows
Outfall
10. Discharge Connection
2. OCF Influent Pipe (CSO Flows)
8. Odor Control
9a. Force Main
Dry Weather Flows - to Interceptor
3. Screening Facilities
7. Effluent Pump Station
4. Detention Basin
6. Disinfection / Dechlorination
5. Dewatering Pump Station
9b. Force Main
OCF Legend
Existing Piping
New Piping
Odor Control Ducting
Interceptor


High Rate Treatment (i.e. Ballasted Flocculation)
Existing Diversion Structure
All Overflows
1. New Regulating Structure
Untreated Overflows
Outfall
11. Discharge Connection
2. OCF Influent Pipe (CSO Flows)
9. Odor Control
10a. Force Main
Dry Weather Flows - to Interceptor
3. Screening Facilities
8. Effluent Pump Station / Dechlorination
7. Contact Tank
4. High Rate Treatment Unit
6. Disinfection
5. Dewatering Pump Station
10b. Force Main
OCF Legend
Existing Piping
New Piping
Odor Control Ducting
Interceptor


Screening & Disinfection
Existing Diversion Structure
All Overflows
1. New Regulating Structure
Untreated Overflows
Outfall
10. Discharge Connection
2. OCF Influent Pipe (CSO Flows)
8. Odor Control
9a. Force Main
Dry Weather Flows - to Interceptor
7. Effluent Pump Station / Dechlorination
6. Contact Tank
3. Screening Facilities
5. Disinfection
4. Dewatering Pump Station
9b. Force Main
OCF Legend
Existing Piping
New Piping
Odor Control Ducting
Interceptor

APPENDIX A. TECHNOLOGY SCREENING RESULTS

System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
Source Control Technologies				
System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
• None	• None	• Sewer & Manhole Rehabilitation	• Sewer & Manhole Rehabilitation	• BMP (all) • Roof Leader / Footing Drain Disconnection • Cross Connection Removal • SMP (all)
Collection System Control Technologies				
System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
• Complete Separation	• Sewer system optimization (all) • Relief Sewer(s) • Complete separation • Partial Separation	• Sewer system optimization (all) • Regulator optimization (all) • Relief Sewer(s) • Complete separation • Partial separation	• Sewer system optimization (all) • Regulator optimization (all) • Relief Sewer(s) • Complete separation • Partial separation	• Inter-basin flow transfer
Storage Technologies				
System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
• Tunnel	• In-line (all) • Tunnel • Closed Concrete tanks • Storage & Conveyance Conduits	• In-line (all) • Closed Concrete tanks • Storage & Conveyance Conduits • Surface	• In-line (all)	• None
Treatment Technologies				
System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
• None	• SS Removal (all) • Screens • Disinfection (all) • High rate end-of-pipe (all) • CSOTF (all) • Sidestream Elevated Pool Aeration	• SS removal (all) • Screens • Regulator Underflow Baffles • Disinfection (all) • High rate end-of-pipe (all) • CSOTF (all)	• None	• Containment Booms • Catch Basin Inserts & Mods • Brush Screens • Carbon Absorption • HGMS • Constructed Wetlands • Enclose Beach Area

Criteria / Technologies	Environmental Impact: Does it reduce or capture the water quality pollutants of concern?	Environmental Impact: Does it reduce the no. of untreated overflow events and volume?	Environmental Impact: Does it effectively capture CSO floatables?	Environmental Impact: Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Implementation Impact: Is it feasible in urban, residential or commercial areas?	Implementation Impact: Can it be physically constructed in the service area?	Operational Impact: Is it compatible with current operating systems?	Operational Impact: Is it a proven, reliable, and flexible system?	Operational Impact: Does it avoid negative impacts to D/S facilities?	Operational Impact: Does it have minimal remote O&M needs?	Potential for Future Use: System-Wide	Potential for Future Use: Region-Wide	Potential for Future Use: Site-Specific	Potential for Future Use: Early Action	Potential for Future Use: Non-Feasible
SOURCE CONTROL: Best Management Practices															
Catch Basin Cleaning, Street Cleaning, Litter Control, Deicer Control, Fertilizer and Pesticide Control, Hazardous Material Control, Industrial Runoff Control, Water Conservation, Public Education, Sewer Use Bylaws, Spills Emergency Program	**0**	**0**	+	+	+	+	+	-	+	-	**N**	**N**	**N**	**N**	**NF**
Other:															

Rationale:
1. Technologies are not reliable and don't significantly reduce pollutant and/or hydraulic loadings.
2. Many technologies are already included in the Nine Minimum Control measures.
3. The effectiveness of these technologies is limited when upstream flows are significant.

Criteria / Technologies	Env: reduce pollutants	Env: reduce overflow	Env: floatables	Env: avoid adverse impacts	Impl: feasible	Impl: constructible	Op: compatible	Op: proven	Op: avoid D/S impacts	Op: minimal O&M	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
SOURCE CONTROL: Infiltration / Inflow Control															
Sewer & Manhole Rehabilitation	**0**	+	**0**	**0**	+	+	+	+	+	+	**N**	**N**	**Y**	**Y**	**F**
Roof Leader / Footing Drain Disconnection	**0**	+	-	**0**	**0**	**0**	**0**	+	+	+	**N**	**N**	**N**	**N**	**NF**
Cross Connection Removal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	+	+	+	**N**	**N**	**N**	**N**	**NF**

Rationale:
1. Roof leader, footing drain and cross connection removals have limited effectiveness in a combined sewer area.

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
SOURCE CONTROL: Storm Water Management Practices															
Upstream Storm Water Storage, Porous Pavement, Infiltration Trenches and Basins, Erosion and Sedimentation Control, Storm Sewer Exfiltration and Infiltration Systems, Water Quality Inlets, Private Property Storage, Storm Water Permitting, Urban Forest Structure	+	+	+	**0**	**0**	**0**	**-**	**0**	+	**-**	**N**	**N**	**N**	**N**	**NF**
Overland Flow Slippage and Catch Basin Restriction	**0**	+	**-**	**-**	**0**	**0**	**-**	+	**0**	**0**	**N**	**N**	**N**	**N**	**NF**

Rationale:
1. Implementation and Operational negatives outweigh the Environmental positives.
2. Overall scores indicate that all technologies are Not Feasible.

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
COLLECTION SYSTEM CONTROLS: Sewer System Optimization															
Remove bottlenecks, Sewer cleaning & maintenance, Polymer injection (lining & coating)	**0**	+	**0**	**0**	+	+	+	+	**0**	+	**N**	**Y**	**Y**	**Y**	**F**
Rationale: 1. Technologies are generally easily implemented and have minimal operational impact; however their environmental effectiveness may be average.															
COLLECTION SYSTEM CONTROLS: Regulator Optimization															
Static regulator device improvements; Swirl / helical, plunge and vortex energy dissipaters; Bending weirs; Drop structure optimization	+	+	**0**	**0**	+	+	+	+	-	**0**	**N**	**N**	**Y**	**Y**	**F**
Rationale: 1. Similar to collection system controls; have greater environmental impact but require more O&M.															
COLLECTION SYSTEM CONTROLS: Inter-basin Flow Balance / Relief															
Inter-basin flow transfer	**0**	+	**0**	-	+	**0**	+	-	**0**	-	**N**	**N**	**N**	**N**	**NF**
Relief sewer(s)	**0**	+	**0**	-	+	+	+	+	-	+	**N**	**Y**	**Y**	**Y**	**F**

Criteria / Technologies	Environmental Impact: Does it reduce or capture the water quality pollutants of concern?	Environmental Impact: Does it reduce the no. of untreated overflow events and volume?	Environmental Impact: Does it effectively capture CSO floatables?	Environmental Impact: Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Implementation Impact: Is it feasible in urban, residential or commercial areas?	Implementation Impact: Can it be physically constructed in the service area?	Operational Impact: Is it compatible with current operating systems?	Operational Impact: Is it a proven, reliable, and flexible system?	Operational Impact: Does it avoid negative impacts to D/S facilities?	Operational Impact: Does it have minimal remote O&M needs?	Potential for Future Use: System-Wide	Potential for Future Use: Region-Wide	Potential for Future Use: Site-Specific	Potential for Future Use: Early Action	Potential for Future Use: Non-Feasible
Rationale: 1. Interbasin flow transfer may be difficult due to terrain and may simply transfer problems elsewhere, where they may arise again. 2. Relief sewers were judged to be feasible, but may also simply transfer problems downstream where they may arise again.															
COLLECTION SYSTEM CONTROLS: Sewer Separation															
Complete Separation	+	+	**0**	**-**	+	+	+	+	+	**0**	**Y**	**Y**	**Y**	**Y**	**F**
Partial Separation	+	+	**0**	**-**	**0**	+	+	+	+	**0**	**N**	**Y**	**Y**	**Y**	**F**
Rationale: 1. Both partial and total separation were judged to be effective; economic impact must be studied at a later date. 2. Partial separation is feasible for site-specific or early-action plans. It will not provide a full level of control in most instances during system-wide applications.															

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
STORAGE: In-Line Storage															
Inflatable Dams, Manual & Automatic Gates, Existing Unused Conduits, Static Flow Control Strategies, Variable Flow Control Strategies, Real-Time Control Strategies	+	+	**0**	+	+	+	**-**	+	+	**-**	**N**	**Y**	**Y**	**Y**	**F**

Rationale:

1. Technologies are normally effective over small areas; good for site-specific or early action projects.
2. Steep local terrain would make it difficult to monitor and control flows.

Technologies	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
STORAGE: Subsurface Storage															
Tunnel Storage	+	+	+	**0**	+	+	**-**	+	+	**-**	**Y**	**Y**	**N**	**N**	**F**
Closed Concrete Tanks	+	+	+	**-**	**0**	+	**0**	+	+	**-**	**N**	**Y**	**Y**	**N**	**F**
Storage and Conveyance Conduits	+	+	+	**-**	**0**	+	**0**	+	+	**0**	**N**	**Y**	**Y**	**N**	**F**

Rationale:

1. Tunnel storage rated high on a system-wide basis, but not for site-specific areas. PWSA does not currently operate similar systems and such a system would require extensive O&M.
2. Closed concrete tanks and storage conduits were not judged to be feasible for system-wide use due to the pumping required to consolidate overflows from different drainage basins.

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
STORAGE: Surface Storage															
Open Concrete Tanks / Earthen Basins	+	+	+	-	-	0	0	+	+	-	N	N	Y	N	F

Rationale:

1. Implementation (open tanks) may be difficult in much of the PWSA service area.
2. High O&M requirements.

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
TREATMENT: Suspended Solids Control															
Microscreens, Gravity Sedimentation, Flocculation & Sedimentation, Dissolved Air Floatation, High Rate Filtration, Sand & Organic Filters, High Rate Sedimentation	+	+	**0**	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Rationale: 1. Must use in conjunction with Floatables and Coarse Solids removal technologies. 2. Specific method(s) of Suspended Solids Control will be determined during the detailed evaluation stage.															
TREATMENT: Floatables & Coarse Solids Control															
Screens: Static, Mechanical, In-Line Netting	**0**	+	+	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Containment Booms	**0**	+	+	**0**	-	+	-	-	**0**	-	**N**	**N**	**N**	**N**	**NF**
Regulator Underflow Baffles	**0**	+	+	**0**	+	+	**0**	+	+	-	**N**	**N**	**Y**	**N**	**F**
Catch Basin Inserts & Modifications	**0**	**0**	+	+	**0**	+	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
Brush Screens	**0**	+	+	**0**	+	+	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
Continuous Deflective Separation	**Not Rated: See High Rate Sedimentation (similar technology).**														

Criteria / Technologies	Environmental Impact: Does it reduce or capture the water quality pollutants of concern?	Environmental Impact: Does it reduce the no. of untreated overflow events and volume?	Environmental Impact: Does it effectively capture CSO floatables?	Environmental Impact: Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Implementation Impact: Is it feasible in urban, residential or commercial areas?	Implementation Impact: Can it be physically constructed in the service area?	Operational Impact: Is it compatible with current operating systems?	Operational Impact: Is it a proven, reliable, and flexible system?	Operational Impact: Does it avoid negative impacts to D/S facilities?	Operational Impact: Does it have minimal remote O&M needs?	Potential for Future Use: System-Wide	Potential for Future Use: Region-Wide	Potential for Future Use: Site-Specific	Potential for Future Use: Early Action	Potential for Future Use: Non-Feasible
Rationale: 1. May require implementation in conjunction with Disinfection and other treatment. 2. In-receiving water methods were not considered feasible in the area's rivers and streams.															
TREATMENT: Disinfection															
Chlorination, Bromination, Ozonation, Microfiltration, Ultraviolet Radiation	+	+	**0**	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Rationale: 1. Cannot be used alone; may require one or more of the following: Floatables & Coarse Solids Removal, Suspended Solids Removal. 2. Specific method(s) of Disinfection will be determined during the detailed evaluation stage.															
TREATMENT: High Rate End-of-Pipe															
Ballasted Flocculation	+	+	**0**	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Clarification (DensaDeg 4D)	+	+	**0**	-	+	+	-	**0**	+	-	**N**	**Y**	**Y**	**N**	**F**
CoMag	+	+	**0**	-	+	+	-	-	+	-	**N**	**Y**	**Y**	**N**	**F**
Rationale: 1. DensaDeg and CoMag are less "proven" technologies than ballasted flocculation.															
TREATMENT: CSO Treatment Facility (CSOTF)															
Storage & Sedimentation	+	+	+	-	+	**0**	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Detention & Treatment	+	+	+	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
Rationale: 1. Detention & treatment basins would generally be smaller than those for storage & sedimentation, thus raising its "implementation impact" score.															
TREATMENT: Others															
Carbon Absorption	**0**	**0**	**0**	**0**	-	+	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
High Gradient Magnetic Separation (HGMS)	+	+	**0**	-	-	+	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
Constructed Wetlands	+	+	**0**	-	-	-	-	**0**	+	**0**	**N**	**N**	**N**	**N**	**NF**
Existing Treatment Plant Exp.	**Not Applicable: this option is not within PWSA's jurisdiction.**														
Enclose Beach Area	+	+	+	-	-	-	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
Sidestream Elevated Pool Aeration	**0**	**0**	**0**	**0**	+	+	**0**	**0**	+	+	**N**	**Y**	**N**	**N**	**F**

Rationale:

1. All technologies must be implemented in conjunction with Floatables & Coarse Solids Control.
2. None of these technologies have been "proven" to be effective at CSO control.
3. High land requirements or inappropriate land uses limit possible implementation.

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January 12, 2007

Mr. Michael D. Lichte, P.E.
Pittsburgh Water and Sewer Authority
441 Smithfield Street
Pittsburgh, PA 15222

Re: CSO Technology Screening
DRAFT Technical Memorandum

Dear Mr. Lichte:

Enclosed for your review is a copy of the DRAFT Technical Memorandum on the CSO Technology Screening process. This process was utilized by the PWSA CSO Team to narrow down the range of technologies that will become part of CSO control alternatives to be considered.

This version contains updates related to review comments received from all Team members during the November – December 2006 time frame.

We look forward to your review of this draft document. Should you have any questions, please feel free to contact us.

Sincerely,

David R. Bingham
(For: CSO Consultant Team)
Vice President, Project Director

CSO Technology Screening
DRAFT Technical Memorandum

TECHNOLOGY SCREENING CRITERIA

Concurrent with the development and evaluation of CSO LTCP alternatives, a set of criteria were used for technology screening. These criteria covered the critical issues that impacted the selection of appropriate control technologies. They provided a way of narrowing down the range of technologies that would become part of alternatives to be considered, so that time was not wasted evaluating technologies that were not feasible. The four main categories of criteria used for the evaluation of technologies were:

- Economic Impact
- Environmental Impact
- Implementation Impact
- Operational Impact

The criteria were further sub-divided so as to best represent the characteristics of each; these sub-divisions are summarized below.

PWSA Long Term CSO Control Plan Technology Screening Criteria

Economic Impact • Present Worth Cost (Capital, Operations and Maintenance)
Environmental Impact • Pollution Reduction • Impact on habitat, stream flooding, etc.
Implementation Impacts • Constructability • Permanent Land Requirements • Public Acceptance • Institutional Constraints • Siting Restrictions
Operational Impact • Operating Complexity • Flexibility • Reliability • Compatibility with other PWSA Facilities and Operations

Brief definitions of these criteria are provided below. These definitions formed the basis for the CSO technology screening queries discussed later.

Economic Impact. The economic impact of alternatives can be measured by calculating the Present Worth Costs of each. This conversion converts life-cycle costs into equivalent annual costs, and allows for consistent economic comparisons between alternatives. The life-cycle cost parameters are:

- Planning interest rate
- Economic lifespan
- Capital costs
- Operation & Maintenance costs

Note that technology screening questions will be directed towards the non-cost criteria due to the difficulty in assessing the impacts of cost prior to the development of control alternatives. Therefore, the Economic Impact criteria were not used to screen CSO control technologies, but were used at a later date to perform the detailed evaluation of CSO control alternatives.

Environmental Impact. The environmental impact of CSO technologies was measured by evaluating the following parameters:

- Pollution Reduction
- Impact on Habitat, Stream, River etc.

Pollution Reduction parameters consisted of pollutant removal efficiencies and maximum possible removals by pollutant type for each CSO control technology under consideration. Pollution indicators and pollutants of concern for this project included:

- CSO volume
- CSO frequency of overflow
- Pathogens and coliform bacteria
- Floatables (debris, scum, raw sewage)
- Total suspended solids (TSS)
- Coarse / settleable solids (sand, grit, debris)
- Oxygen demand components (BOD, COD)
- Nuisance components (odor, color)
- Nutrients (phosphates, nitrogen)
- Toxins (heavy metals, hydrocarbons, chlorinated hydrocarbons)

Impact on Habitat, Stream, River etc. parameters consisted of permanent operating impacts to the environment, including such factors as:

- Reduction of natural habitat from construction of new facilities in previously undisturbed areas.
- Increase in run-off pollutants and/or stream erosion from new facilities.
- Maximization of visual compatibility, i.e. the new facilities blend in with the surrounding area or are installed below grade.
- Minimization of visual nuisances such as floating debris, scum, oil and grease.
- Minimization of noise and odor.

- Minimization of unsafe conditions due to possible chemical leakage or flooding.
- Minimization of possible unauthorized access that may cause injuries or system failures.

Implementation Impact. The implementation impact of CSO technologies was measured by evaluating the following parameters:

- Constructability
- Permanent land requirements
- Public acceptance
- Institutional constraints
- Siting restrictions

Constructability parameters consisted of the level of design and construction sophistication of the CSO control technology. The constructability impacts to be minimized included:

- Time required for design and construction
- Level of disturbance to traffic patterns and business activity
- Soil erosion
- Excessive construction noise
- Site security and safety

Permanent land requirement parameters were based on the following considerations:

- Availability of land
- Site requirements (relative area required)

Public acceptance parameters consisted of the relative levels of probable public acceptance based on the following:

- Known / expected responses from community, neighborhood and business groups
- Citizen responses at public meetings and other forms of media

Institutional constraint parameter**s** consisted of questions related to which agency or agencies would own and/or operate the CSO control and what interagency agreements would be required to implement the technology.

Siting restriction parameters involved the feasibility of the CSO technology being accepted for use as a control measure within the PWSA area. This included the level of regulatory agency / authority permitting required for implementation of the technology as a part of a control alternative. It also included the extent of construction easements, environmental permits, transportation permits, community construction permits, and/or the approval of a technology through a piloting process. Specific concerns for surrounding land uses were:

- Minimize use of sensitive areas - Sensitive areas are those having high social or environmental concern. Examples include historic sites or environmentally productive sites.
- Minimize use of residential areas.
- Minimize use of areas where surrounding land use would be adversely impacted.

Operational Impact. The operational impact of CSO technologies was screened by reviewing the following parameters:

- Operating complexity
- Flexibility
- Reliability
- Compatibility with other PWSA facilities and operations

Operating complexity parameters considered the relative operation and maintenance complexity of the control technology, including safety and accessibility for operators and maintenance crews.

Flexibility parameters considered the control technology in terms of its future expansion and/or retrofit capability.

Reliability parameters involved the CSO control technology's relative reliability, including its historical track record, known maintenance problems, and reported design shortcomings.

Compatibility with other PWSA facilities and operations parameters included PWSA's familiarity with similar facilities and if PWSA currently owned and/or operated similar facilities. Preference was given to technologies for which PWSA had trained operations and maintenance personnel on staff, and to technologies that did not have a negative impact on downstream facilities. Higher consideration was also given to technologies that did not require extensive and/or remote facility operations and maintenance needs.

TECHNOLOGY SCREENING APPROACH

The above definitions for the screening criteria were used to develop screening level queries for the determination as to whether a particular CSO control technology should be used to develop short and long term control alternatives. The technology screening queries were directed towards the non-cost criteria because it was difficult to assess the impacts of cost prior to the development of control alternatives. Therefore, the Economic Impact criteria were not used to screen CSO control technologies.

The screening queries for the Environmental, Implementation and Operational impact criteria are summarized below:

Criteria	Screening Level Queries
Environmental Impact	1. Does the technology reduce or capture the water quality pollutants of concern? 2. Does the technology reduce the number of untreated overflow events and volume? 3. Does technology effectively capture CSO floatables? 4. Does implementation of this technology avoid adverse impacts to sensitive areas, habitat, river etc.?
Implementation Impact	1. Is the technology feasible (public acceptance, construction impact etc.) in urban, residential or commercial areas? 2. Can the technology be physically constructed in the service area given its land requirements, site restrictions etc?
Operational Impact	1. Is the technology compatible with current operating systems with respect to specialized staff or new staff requirements? 2. Is the technology a proven, reliable, and flexible system? 3. Does the technology avoid negative impacts to downstream (PWSA or ALCOSAN) facilities? 4. Does the technology have minimal remote O&M needs?

The above queries were formulated so that consistent responses would occur relative to positive and negative impacts. For example, a "yes" answer would always be positive and a "no" answer would always be negative. However, instead of using "yes" or "no" answers, a rating scale of "+", "0", and "–" was employed to address positive, neutral, and negative responses to the questions. To that end, the responses to the screening questions were established as follows:

- "**+**" indicated a Positive Impact / Improvement
- "**0**" indicated a Neutral Impact / No Improvement
- "**-**" indicated a Negative Impact / Deterioration

After each CSO control technology was subjected to the screening questions, an assessment was made of its future use in the PWSA service area, as defined below:

- **System Wide Technology** – The technology clearly scored well over the range of evaluation criteria, and was a logical CSO control technology to be applied System Wide in the PWSA service area.
- **Region Wide Technology -** The technology clearly scored well over the range of evaluation criteria, and was a logical CSO control technology to be applied Region Wide (i.e. to a group of CSOs) in the PWSA service area.
- **Site Specific Technology** – The technology scored reasonably well over a range of criteria and may best be applied to the development of Site Specific CSO control alternatives.
- **Early Action Technology –** The technology scored reasonably well over a range of criteria, but may best be implemented independently as part of an "Early Action" program.
- **Non-Feasible Technology** – The technology consistently scored poorly over a range of criteria and will not be a logical choice for inclusion in the detailed evaluation phase.

Technology screening worksheets were utilized by each Team member during the screening process. Each team member reviewed the worksheet prior to holding a meeting in which each technology was discussed in-depth. Once a consensus was reached on the final score and rationale for each technology, the results were summarized on a “final” worksheet.

TECHNOLOGY SCREENING RESULTS

As described in previous sections, each of the technologies were grouped into one of the following four technology categories:

- Source Control
- Collection System Controls
- Storage
- Treatment

Each team member recorded their own scores and screening rationale on their own screening worksheet. The individual worksheets were then combined into a “final” worksheet that indicated the final Team scores for each technology.

A text summary of the screening results is given below; for details on the screening scores and rationale, see the “final” worksheet included as Appendix B.

Source Control. This category included the following sub-categories of technologies:

- Best Management Practices
- Infiltration / Inflow Control
- Stormwater Management Practices

The results of the screening process are described below.

Best Management Practices (BMP) were screened as indicated below:

Best Management Practices (BMP)	
Feasible Technologies	Non-Feasible Technologies
• None	• Catch Basin Cleaning • Street Cleaning • Litter Control • Deicer Control • Fertilizer and Pesticide Control • Hazardous Material Control • Industrial Runoff Control • Water Conservation • Public Education

	• Sewer Use Bylaws • Spills Emergency Program

These technologies were screened as a group, and as such, they were considered to be Non-Feasible with the following rationale:

- The technologies are not reliable and don’t significantly reduce pollutant and/or hydraulic loadings.
- Many of these technologies are already included in the Nine Minimum Control measures.
- The effectiveness of these technologies is limited when upstream flows are significant.

Infiltration / Inflow Control technologies were screened as indicated below:

Infiltration / Inflow Control	
Feasible Technologies	Non-Feasible Technologies
Site Specific and/or Early Action: • Sewer & Manhole Rehabilitation	• Roof Leader / Footing Drain Disconnection • Cross Connection Removal

These technologies were screened individually. Of the three technologies, only Sewer & Manhole Rehabilitation was considered to be feasible for use as a Site Specific and/or Early Action technology. The others were considered Non-Feasible for the following reason:

- Roof leader, footing drain and cross connection removals have limited effectiveness in a combined sewer area.

Stormwater Management Practices (SMP) were screened as indicated below:

Stormwater Management Practices (SMP)	
Feasible Technologies	Non-Feasible Technologies
• None	• Upstream Stormwater Storage • Porous Pavement • Infiltration Trenches & Basins • Erosion & Sedimentation Control • Storm Sewer Exfiltration & Infiltration Systems • Water Quality Inlets • Private Property Storage • Stormwater Permitting • Urban Forest Structure • Overland Flow Slippage & Catch Basin Restriction

These technologies were screened as a group, with the exception of Overland Flow Slippage & Catch Basin Restriction. However, they were all considered to be Non-Feasible with the following rationale:

- Implementation and Operational "negatives" outweighed the Environmental "positives".
- The overall scores indicated that all the technologies are Non-Feasible.

Collection System Controls. This category included the following sub-categories of technologies:

- Sewer System Optimization
- Regulator Optimization
- Inter-Basin Flow Balance / Relief
- Sewer Separation

The results of the screening process are described below.

Sewer System Optimization technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide, Site Specific and/or Early Action: • Removal of bottlenecks • Sewer cleaning & maintenance • Polymer injection (lining & coating)	• None

These technologies were screened as a group, and as such, they were considered to be feasible for use as a Region Wide, Site Specific and/or Early Action technology with the following rationale:

- The technologies are generally easily implemented and have minimal operational impact; however their environmental effectiveness may be average.

Regulator Optimization technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Site Specific and/or Early Action: • Static regulator device improvements • Swirl / helical, plunge and vortex energy dissipaters • Bending weirs	• None

• Drop structure optimization	

These technologies were screened as a group, and as such, they were considered to be feasible for use as a Site Specific and/or Early Action technology with the following rationale:

- The technologies are similar to collection system controls and have greater environmental impacts. However, they require more O&M.

Inter-basin Flow Balance / Relief technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide, Site Specific and/or Early Action: • Relief Sewer(s)	• Inter-basin flow transfer

These technologies were screened individually. Of the two technologies, only relief sewer(s) technology was deemed to be feasible for use as a Region Wide, Site Specific and/or Early Action technology, despite the reasoning that a relief sewer may simply transfer problems downstream where they may arise again.

Inter-basin flow transfer was deemed to be Non-Feasible for the following reason:

- Inter-basin flow transfer may be difficult due to terrain and may simply transfer problems elsewhere, where they may arise again.

Sewer Separation technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
System Wide, Region Wide, Site Specific and/or Early Action: • Complete separation Region Wide, Site Specific and/or Early Action: • Partial separation	• None

These technologies were screened individually, and complete separation was deemed to be feasible for use as a System Wide, Region Wide, Site Specific and/or Early Action technology while partial separation was deemed to be feasible for use as a Region Wide, Site Specific and/or Early Action technology. The following rationale apply:

- Both partial and total separation are judged to be effective; economic impact must be studied at a later date.
- Partial separation is feasible for Site Specific or Early Action plans. It will not provide a full level of control in most instances during System Wide applications.

Storage. This category included the following sub-categories of technologies:

- In-Line Storage
- Sub-Surface Storage
- Surface Storage

The results of the screening process are described below.

In-Line Storage technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide, Site Specific and/or Early Action: • Inflatable Dams • Manual & Automatic Gates • Existing Unused Conduits • Static Flow Control Strategies • Variable Flow Control Strategies • Real-Time Control Strategies	• None

These technologies were screened as a group, and as such, they were considered to be feasible for use as a Region Wide, Site Specific and/or Early Action technology with the following rationale:

- Technologies are normally effective over small areas; good for Region Wide, Site Specific or early action projects.
- Steep local terrain would make it difficult to monitor and control flows.

Sub-Surface Storage technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
System Wide and/or Region Wide: • Tunnel Storage Region Wide and/or Site Specific: • Closed Concrete tanks • Storage & Conveyance Conduits	• None

These technologies were screened individually. Tunnel Storage was deemed to be feasible for System Wide and Region Wide use, while each of the others was deemed to be feasible for Region Wide and Site Specific use. The following rationale applies:

- Tunnel storage rated high on a System and Region Wide basis, but not for Site Specific areas. PWSA does not currently operate similar systems and such a system would require extensive O&M.
- Closed concrete tanks and storage conduits were not judged to be feasible for System Wide use due to the pumping required to consolidate overflows from different drainage basins.

Surface Storage technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Site Specific: • Open Concrete Tanks / Earthen Basins	• None

Open concrete tanks / earthen basin storage was deemed to be feasible for use as a Site Specific technology with the following rationale:

- Implementation (open tanks) may be difficult in much of the PWSA service area.
- High O&M requirements.

Treatment. This category included the following sub-categories of technologies:

- Suspended Solids Control
- Floatables & Coarse Solids Control
- Disinfection
- High Rate End-of-Pipe
- CSO Treatment Facilities
- "Other" Treatment Technologies

The results of the screening process are described below.

Suspended Solids Control technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide and/or Site Specific: • Microscreens • Gravity Sedimentation • Flocculation & Sedimentation • Dissolved Air Floatation • High Rate Filtration • Sand & Organic Filters • High Rate Sedimentation	• None

These technologies were screened as a group, and as such, they were considered to be feasible for use as a Region Wide and/or Site Specific technology with the following rationale:

- Must use in conjunction with Floatables and Coarse Solids removal technologies.
- Specific method(s) of Suspended Solids Control will be determined during the detailed evaluation stage.

Floatables & Coarse Solids Control technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide and/or Site Specific: • Screens, including Static, Mechanical and In-Line Netting Site Specific: • Regulator Underflow Baffles	• Containment Booms • Catch Basin Inserts & Modifications • Brush Screens
Note: Continuous deflective separation technology was not scored; the Team decided that it should be re-categorized as High Rate Sedimentation, which was already screened as part of the Suspended Solids Control technology group.	

These technologies were screened individually. Screens were deemed to be feasible for Region Wide and/or Site Specific use while underflow baffles were deemed to be feasible for Site Specific use. The following rationale applies:

- Technology may require implementation in conjunction with Disinfection and other treatment.
- In-receiving water methods were not considered feasible in the area's rivers and streams.

Containment booms, catch basin inserts & modifications and brush screens were deemed to be Non-Feasible due to consistently poor scores on the Operational Impact criteria.

Disinfection technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide and/or Site Specific: • Chlorination • Bromination • Ozonation • Microfiltration • Ultraviolet Radiation	• None

These technologies were screened as a group, and as such, they were considered to be feasible for use as a Region Wide and/or Site Specific technology with the following rationale:

- Technology cannot be used alone; may require one or more of the following: Floatables & Coarse Solids Removal, Suspended Solids Removal.
- Specific method(s) of Disinfection will be determined during the detailed evaluation stage.

High Rate End-of-Pipe technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide and/or Site Specific: • Ballasted Flocculation • Clarification (DensaDeg 4D) • CoMag	• None

These technologies were screened individually, and each was considered to be feasible for use as a Site Specific technology with the following rationale:

- DensaDeg and CoMag are less "proven" technologies than ballasted flocculation.

CSO Treatment Facility (CSOTF) technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide and/or Site Specific: • Storage & Sedimentation • Detention & Treatment	• None

These technologies were screened individually, and each was considered to be feasible for use as a Region Wide and/or Site Specific technology with the following rationale:

- Both are accepted CSO control technologies.
- Detention & treatment basins would generally be smaller than those for storage & sedimentation, thus raising its "implementation impact" score.

"Other" technologies were screened as indicated below:

Feasible Technologies	Non-Feasible Technologies
Region Wide: • Sidestream Elevated Pool Aeration	• Carbon Absorbtion • High Gradient Magnetic Separation (HGMS) • Constructed Wetlands • Existing Treatment Plant Expansion • Enclose Beach Area

These technologies were screened individually, and only Sidestream Elevated Pool Aeration was deemed to be feasible for Region Wide use. The others were considered to be Non-Feasible, with the following rationale:

- All technologies must be implemented in conjunction with Floatables & Coarse Solids Control.
- None of these technologies have been "proven" to be effective at CSO control.
- High land requirements or inappropriate land uses limit possible implementation.
- Expanding the existing treatment plant is not an applicable option since it is not within PWSA's jurisdiction to do so.

CONCLUSION

The table below illustrates the CSO control technologies that have been screened for use in the development of PWSA's CSO control alternatives. The control alternatives may include a single technology or a combination of many technologies, depending upon the desired level of CSO control. A detailed record of the screening process is included in Appendix A – Technology Screening Matrix (attached).

Each CSO control alternative will then be subjected to a detailed alternatives evaluation process. The results of this process, when combined with the appropriate level of control for a specific site or sites, will allow PWSA to select the most desirable CSO control level and its supporting alternatives.

Technology Screening - Summary of Recommended Uses

Source Control Technologies				
System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
• None	• None	• Sewer & Manhole Rehabilitation	• Sewer & Manhole Rehabilitation	• BMP (all) • Roof Leader / Footing Drain Disconnection • Cross Connection Removal • SMP (all)
Collection System Control Technologies				
System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
• Complete Separation	• Sewer system optimization (all) • Relief Sewer(s) • Complete separation • Partial Separation	• Sewer system optimization (all) • Regulator optimization (all) • Relief Sewer(s) • Complete separation • Partial separation	• Sewer system optimization (all) • Regulator optimization (all) • Relief Sewer(s) • Complete separation • Partial separation	• Inter-basin flow transfer
Storage Technologies				
System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
• Tunnel	• In-line (all) • Tunnel • Closed Concrete tanks • Storage & Conveyance Conduits	• In-line (all) • Closed Concrete tanks • Storage & Conveyance Conduits • Surface	• In-line (all)	• None
Treatment Technologies				
System Wide	Region Wide	Site Specific	Early Action	Non-Feasible
• None	• SS Removal (all) • Screens • Disinfection (all) • High rate end-of-pipe (all) • CSOTF (all) • Sidestream Elevated Pool Aeration	• SS removal (all) • Screens • Regulator Underflow Baffles • Disinfection (all) • High rate end-of-pipe (all) • CSOTF (all)	• None	• Containment Booms • Catch Basin Inserts & Mods • Brush Screens • Carbon Absorption • HGMS • Constructed Wetlands • Enclose Beach Area

Appendix A – Technology Screening Matrix

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
SOURCE CONTROL: Best Management Practices															
Catch Basin Cleaning, Street Cleaning, Litter Control, Deicer Control, Fertilizer and Pesticide Control, Hazardous Material Control, Industrial Runoff Control, Water Conservation, Public Education, Sewer Use Bylaws, Spills Emergency Program	**0**	**0**	+	+	+	+	+	-	+	-	**N**	**N**	**N**	**N**	**NF**
Other:															
Rationale: 1. Technologies are not reliable and don't significantly reduce pollutant and/or hydraulic loadings. 2. Many technologies are already included in the Nine Minimum Control measures. 3. The effectiveness of these technologies is limited when upstream flows are significant.															
SOURCE CONTROL: Infiltration / Inflow Control															
Sewer & Manhole Rehabilitation	**0**	+	**0**	**0**	+	+	+	+	+	+	**N**	**N**	**Y**	**Y**	**F**
Roof Leader / Footing Drain Disconnection	**0**	+	-	**0**	**0**	**0**	**0**	+	+	+	**N**	**N**	**N**	**N**	**NF**
Cross Connection Removal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	+	+	+	**N**	**N**	**N**	**N**	**NF**
Rationale: 1. Roof leader, footing drain and cross connection removals have limited effectiveness in a combined sewer area.															

Appendix A – Technology Screening Matrix

Criteria / **Technologies**	**Environmental Impact**				**Implementation Impact**		**Operational Impact**				**Potential for Future Use**				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
SOURCE CONTROL: Storm Water Management Practices															
Upstream Storm Water Storage, Porous Pavement, Infiltration Trenches and Basins, Erosion and Sedimentation Control, Storm Sewer Exfiltration and Infiltration Systems, Water Quality Inlets, Private Property Storage, Storm Water Permitting, Urban Forest Structure	+	+	+	**0**	**0**	**0**	**-**	**0**	+	**-**	**N**	**N**	**N**	**N**	**NF**
Overland Flow Slippage and Catch Basin Restriction	**0**	+	**-**	**-**	**0**	**0**	**-**	+	**0**	**0**	**N**	**N**	**N**	**N**	**NF**

Rationale:

1. Implementation and Operational negatives outweigh the Environmental positives.
2. Overall scores indicate that all technologies are Not Feasible.

Appendix A – Technology Screening Matrix

Criteria / **Technologies**	**Environmental Impact**				**Implementation Impact**		**Operational Impact**				**Potential for Future Use**				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
COLLECTION SYSTEM CONTROLS: Sewer System Optimization															
Remove bottlenecks, Sewer cleaning & maintenance, Polymer injection (lining & coating)	**0**	+	**0**	**0**	+	+	+	+	**0**	+	**N**	**Y**	**Y**	**Y**	**F**
Rationale: 1. Technologies are generally easily implemented and have minimal operational impact; however their environmental effectiveness may be average.															
COLLECTION SYSTEM CONTROLS: Regulator Optimization															
Static regulator device improvements; Swirl / helical, plunge and vortex energy dissipaters; Bending weirs; Drop structure optimization	+	+	**0**	**0**	+	+	+	+	**-**	**0**	**N**	**N**	**Y**	**Y**	**F**
Rationale: 1. Similar to collection system controls; have greater environmental impact but require more O&M.															
COLLECTION SYSTEM CONTROLS: Inter-basin Flow Balance / Relief															
Inter-basin flow transfer	**0**	+	**0**	-	+	**0**	+	-	**0**	-	**N**	**N**	**N**	**N**	**NF**
Relief sewer(s)	**0**	+	**0**	-	+	+	+	+	-	+	**N**	**Y**	**Y**	**Y**	**F**

Appendix A – Technology Screening Matrix

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
Rationale: 1. Interbasin flow transfer may be difficult due to terrain and may simply transfer problems elsewhere, where they may arise again. 2. Relief sewers were judged to be feasible, but may also simply transfer problems downstream where they may arise again.															
COLLECTION SYSTEM CONTROLS: Sewer Separation															
Complete Separation	+	+	**0**	-	+	+	+	+	+	**0**	**Y**	**Y**	**Y**	**Y**	**F**
Partial Separation	+	+	**0**	-	**0**	+	+	+	+	**0**	**N**	**Y**	**Y**	**Y**	**F**
Rationale: 1. Both partial and total separation were judged to be effective; economic impact must be studied at a later date. 2. Partial separation is feasible for site-specific or early-action plans. It will not provide a full level of control in most instances during system-wide applications.															

Appendix A – Technology Screening Matrix

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
STORAGE: In-Line Storage															
Inflatable Dams, Manual & Automatic Gates, Existing Unused Conduits, Static Flow Control Strategies, Variable Flow Control Strategies, Real-Time Control Strategies	+	+	**0**	+	+	+	-	+	+	-	**N**	**Y**	**Y**	**Y**	**F**

Rationale:
1. Technologies are normally effective over small areas; good for site-specific or early action projects.
2. Steep local terrain would make it difficult to monitor and control flows.

Criteria / Technologies	Env. 1	Env. 2	Env. 3	Env. 4	Impl. 1	Impl. 2	Op. 1	Op. 2	Op. 3	Op. 4	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
STORAGE: Subsurface Storage															
Tunnel Storage	+	+	+	**0**	+	+	-	+	+	-	**Y**	**Y**	**N**	**N**	**F**
Closed Concrete Tanks	+	+	+	-	**0**	+	**0**	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Storage and Conveyance Conduits	+	+	+	-	**0**	+	**0**	+	+	**0**	**N**	**Y**	**Y**	**N**	**F**

Rationale:
1. Tunnel storage rated high on a system-wide basis, but not for site-specific areas. PWSA does not currently operate similar systems and such a system would require extensive O&M.
2. Closed concrete tanks and storage conduits were not judged to be feasible for system-wide use due to the pumping required to consolidate overflows from different drainage basins.

Appendix A – Technology Screening Matrix

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
STORAGE: Surface Storage															
Open Concrete Tanks / Earthen Basins	+	+	+	-	-	**0**	**0**	+	+	-	**N**	**N**	**Y**	**N**	**F**

Rationale:
1. Implementation (open tanks) may be difficult in much of the PWSA service area.
2. High O&M requirements.

Appendix A – Technology Screening Matrix

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
TREATMENT: Suspended Solids Control															
Microscreens, Gravity Sedimentation, Flocculation & Sedimentation, Dissolved Air Floatation, High Rate Filtration, Sand & Organic Filters, High Rate Sedimentation	+	+	**0**	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Rationale: 1. Must use in conjunction with Floatables and Coarse Solids removal technologies. 2. Specific method(s) of Suspended Solids Control will be determined during the detailed evaluation stage.															
TREATMENT: Floatables & Coarse Solids Control															
Screens: Static, Mechanical, In-Line Netting	**0**	+	+	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Containment Booms	**0**	+	+	**0**	-	+	-	-	**0**	-	**N**	**N**	**N**	**N**	**NF**
Regulator Underflow Baffles	**0**	+	+	**0**	+	+	**0**	+	+	-	**N**	**N**	**Y**	**N**	**F**
Catch Basin Inserts & Modifications	**0**	**0**	+	+	**0**	+	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
Brush Screens	**0**	+	+	**0**	+	+	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
Continuous Deflective Separation	**Not Rated: See High Rate Sedimentation (similar technology).**														

Appendix A – Technology Screening Matrix

Criteria	**Environmental Impact**				**Implementation Impact**		**Operational Impact**				**Potential for Future Use**				
Technologies	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
Rationale: 1. May require implementation in conjunction with Disinfection and other treatment. 2. In-receiving water methods were not considered feasible in the area's rivers and streams.															
TREATMENT: Disinfection															
Chlorination, Bromination, Ozonation, Microfiltration, Ultraviolet Radiation	+	+	**0**	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Rationale: 1. Cannot be used alone; may require one or more of the following: Floatables & Coarse Solids Removal, Suspended Solids Removal. 2. Specific method(s) of Disinfection will be determined during the detailed evaluation stage.															
TREATMENT: High Rate End-of-Pipe															
Ballasted Flocculation	+	+	**0**	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Clarification (DensaDeg 4D)	+	+	**0**	-	+	+	-	**0**	+	-	**N**	**Y**	**Y**	**N**	**F**
CoMag	+	+	**0**	-	+	+	-	-	+	-	**N**	**Y**	**Y**	**N**	**F**
Rationale: 1. DensaDeg and CoMag are less "proven" technologies than ballasted flocculation.															
TREATMENT: CSO Treatment Facility (CSOTF)															
Storage & Sedimentation	+	+	+	-	+	**0**	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**
Detention & Treatment	+	+	+	-	+	+	-	+	+	-	**N**	**Y**	**Y**	**N**	**F**

Appendix A – Technology Screening Matrix

Criteria / Technologies	Environmental Impact				Implementation Impact		Operational Impact				Potential for Future Use				
	Does it reduce or capture the water quality pollutants of concern?	Does it reduce the no. of untreated overflow events and volume?	Does it effectively capture CSO floatables?	Does it avoid adverse impacts to sensitive areas, habitat, river etc?	Is it feasible in urban, residential or commercial areas?	Can it be physically constructed in the service area?	Is it compatible with current operating systems?	Is it a proven, reliable, and flexible system?	Does it avoid negative impacts to D/S facilities?	Does it have minimal remote O&M needs?	System-Wide	Region-Wide	Site-Specific	Early Action	Non-Feasible
Rationale: 1. Detention & treatment basins would generally be smaller than those for storage & sedimentation, thus raising its "implementation impact" score.															
TREATMENT: Others															
Carbon Absorption	**0**	**0**	**0**	**0**	-	+	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
High Gradient Magnetic Separation (HGMS)	+	+	**0**	-	-	+	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
Constructed Wetlands	+	+	**0**	-	-	-	-	**0**	+	**0**	**N**	**N**	**N**	**N**	**NF**
Existing Treatment Plant Exp.	**Not Applicable: this option is not within PWSA's jurisdiction.**														
Enclose Beach Area	+	+	+	-	-	-	-	-	+	-	**N**	**N**	**N**	**N**	**NF**
Sidestream Elevated Pool Aeration	**0**	**0**	**0**	**0**	+	+	**0**	**0**	+	+	**N**	**Y**	**N**	**N**	**F**

Rationale:

1. All technologies must be implemented in conjunction with Floatables & Coarse Solids Control.
2. None of these technologies have been "proven" to be effective at CSO control.
3. High land requirements or inappropriate land uses limit possible implementation.

Appendix C
No Activation, Remote Location and Low Flow Alternative Analysis Summary

1.0 Introduction

This appendix presents the results of the evaluation for all of the outfalls in the PWSA Service Area that had, under the Typical Year 2005 model, no activations,, had low flows, or were physically isolated from other outfalls. Controlling the CSOs from these outfalls would require projects that could be easily implemented by PWSA at low relative cost that would result in the elimination or reduction of the number of overflows to less than four overflows per year. Costs for pipe storage and sewer separation were developed for each of these outfalls. The highest cost of these two control alternatives was carried forward as a budgetary place holder for these outfalls.

2.0 Methodology

Two main criteria were used to identify potential early action projects. Outfalls that had less than 1.5 cfs for control level 4 (4 overflows per year) were targeted as Low Flow outfalls. PWSA outfalls that are low flow and isolated from other outfalls were also identified as Remote Location outfalls. Some of the Remote Location outfalls were also evaluated under the Outfall Specific Alternatives Analysis so that PWSA has additional CSO Control Technology choices at these locations. Some of the Low Flow outfalls are located such that they can easily be included in a Consolidation or Regional group of outfalls. This may be the case if a low flow outfall lies between two larger ones that will be connected with a consolidation pipe to convey flows to one CSO treatment facility. It should be noted that several diversion structures in the Plummers Run sewershed were evaluated as low flow-remote outfalls because small areas flow to these diversion structures; they are physically remote from the outfall to which they contribute flow; the remaining large area draining to the Plummers Run overflow is a separate storm system; and a large component of this outfall is baseflow from Plummers Run.

There were several outfalls that, according to model results, have no activations throughout the year for 4 overflows a year. These "no activation" outfalls are not considered further in the alternatives analysis process.

Appendix C
No Activation, Remote Location and Low Flow Alternative Analysis Summary

Figure C-1 shows the locations of the No Activation, Remote Location, and Low Flow outfalls. The names of outfalls are listed below and more detailed information for each outfall is presented on Table C-1, including volumes and peak flow rates for CSO control levels 0 through 6, and the other reports, if any, these outfalls might be included in. It is noted that, within the East Sewershed, remote and low flow outfalls were either included within a region or were delineated as a region; therefore, they were not included within the remote and low flow alternative analysis.

<u>NORTH SEWERSHED REGIONS</u>

1. A-49 – Dasher Street
2. CSO 163G001 – East Street
3. A-63 – East Street
4. O-35 – Pennsylvania Avenue

<u>SOUTH SEWERSHED REGIONS</u>

1. C-26A – Upper Chartiers Creek
2. CSO 039E001 – Bells Run
3. CSO 039J001 – Bells Run
4. CSO 068H001 – Bells Run
5. S-28 – Sawmill Run Interceptor
6. S-42 – McCartney Run
7. CSO 016A002 – Little Sawmill Run
8. CSO 139B003 – McDonoughs Run
9. CSO 139F001 – McDonoughs Run
10. S-30 – Sawmill Run Interceptor
11. S-34 – Sawmill Run Interceptor

Appendix C
No Activation, Remote Location and Low Flow Alternative Analysis Summary

12. DC 034N001 – Plummers Run
13. DC 035P001 – Plummers Run
14. DC 035S001 – Plummers Run
15. DC 035S002 – Plummers Run
16. DC 062C001 – Plummers Run
17. DC 062C002 – Plummers Run
18. DC 062D001 – Plummers Run
19. DC 062K001 – Plummers Run
20. DC 062K002 – Plummers Run
21. CSO 034R001 – Sawmill Run Interceptor
22. CSO 138J001 – Weyman Street
23. CSO 138P001 – Weyman Street
24. CSO 138K001 – Weyman Street
25. M-11A – Arlington through 25th
26. M-17 – Arlington through 25th
27. M-24 – Arlington through 25th
28. CSO 030N001 – Becks Run
29. CSO 032N001 – Becks Run
30. CSO 032P001 – Becks Run
31. CSO 134A001 – Streets Run
32. CSO 184E001 – Streets Run
33. CSO 185H001 – Streets Run

3.0 Results Summary

Appendix C
No Activation, Remote Location and Low Flow Alternative Analysis Summary

For each Remote Location and Low Flow outfall, costs were developed for pipe storage and sewer separation. Sewer separation costs are based on the area of the sewer shed that is tributary to the outfall. Pipe storage costs were based on the volume of the overflows. The costs for these early action alternatives for a control level of 4 overflows per year are presented in Table C-2. The higher cost of the CSO control technology alternatives will be carried forward as a budgetary place holder for potential components of the final recommended alternative that will be developed for the entire PWSA Service Area.

APPENDIX C

PWSA NORTH SEWERSHEDS

C.1 Dasher Street

C.1.1 ACSO 008MA49 – NPDES#008MA49

C.2 Spring Garden

C.2.1 ACSO 048NA43 – NPDES#048NA63

C.3 East Street

C.3.1 CSO 163G001 – NPDES#163G001

C.4 Pennsylvania Avenue

C.4.1 ACSO 021SO35 – NPDES#021SO35

PWSA SOUTH SEWERSHEDS

C.5 Bells Run and Upper Chartiers Creek

C.5.1 ACSO 079FC26A – NPDES#079FC26A

C.5.2 CSO 039E001– NPDES#039E001

C.5.3 CSO 0039J001 – NPDES#039J001

C.5.4 CSO 068H001 – NPDES#068H001

C.6 Sawmill Run Interceptor

C.6.1 ACSO 034LS28 – NPDES#na

C.6.2 ACSO 015JS34 – NPDES#na

C.6.3 CSO 034R001 – NPDES#034R001

C.7 Little Sawmill Run

C.7.1 CSO 016A002 – NPEDS#016A002

C.8 Plummers Run

C.8.1 DC 034N001– NPDES#015P001

C.8.2 DC 035P001 – NPDES#015P001

C.8.3 DC 035S001 – NPDES#015P001

C.8.4 DC 062C001 – NPDES#015P001

ATTACHMENT C - APPENDIX C

Table C-1
No Activation, Remote Location and Low Volume Outfall Summary

System	Structure Name	Classification	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	No Activation Outfall	Remote or Low Volume Outfall	Peak Volume (MG)					Peak Flowrate (MGD)			
								0 Overflows	1 Overflow	2 Overflows	4 Overflows	6 Overflows	0 Overflows	1 Overflow	2 Overflows	4 Overflows
Allegheny North	ACSO 008MA49	Outfall	Allegheny River	Dasher Street	008MA49	--	Y	0.04	0.02	0.02	0	0	2.29	1.2	0.78	0.4
	ACSO 048NA63	Outfall	Allegheny River	Spring Garden	048NA63	--	Y	0.25	0.04	0.03	0.02	0.01	2.47	2.04	1.64	1.14
	CSO 163G001	Outfall	Allegheny River	East Street	163G001	--	Y	0.37	0.15	0.12	0.05	0.03	12.01	8.18	5.18	0.92
Chartiers Creek	ACSO 079FC26A	Outfall	Chartiers Creek	Upper Chartiers Creek	067FC26A	--	Y	0.05	0.03	0.01	0.01	0	3.19	1.72	1.09	0.63
	CSO 039E001	Outfall	Chartiers Creek	Bells Run	039E001	--	Y	0.04	0.02	0.01	0.01	0.01	0.24	0.16	0.16	0.11
	CSO 039J001	Outfall	Chartiers Creek	Bells Run	039J001	--	Y	0.04	0.01	0.01	0.01	0	0.39	0.25	0.23	0.15
	CSO 068H001	Outfall	Chartiers Creek	Bells Run	068H001	--	Y	0.02	0.01	0.01	0	0	1.25	0.91	0.59	0.34
Sawmill Run	ACSO 034LS28	Outfall	Ohio River	Sawmill Run Interceptor (O-14)		--	Y	0.03	0.01	0.01	0		2.41	1.58	1.19	0.43
	ACSO 019MS42	Outfall	Sawmill Run	McCartney Run		Y	--	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations
	CSO 016A002	Outfall	Sawmill Run	Little Sawmill Run	016A002	--	Y	0.16	0.05	0.02	0.01	0	7.94	5.42	2.66	1.18
	CSO 139B003	Outfall	Sawmill Run	McDonoughs Run	139B003	--	Y	0.02	0.01	0.01	0.01	0.01	0.8	0.69	0.64	0.63
	CSO 139F001	Outfall	Sawmill Run	McDonoughs Run	139F001	Y	--	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations
	ACSO 034BS30	Outfall	Ohio River	Sawmill Run Interceptor (O-14)		Y	--	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations
	ACSO 015JS34	Outfall	Ohio River	Sawmill Run Interceptor (O-14)			Y	0.09	0.03	0.02	0.01	0	8.83	3.18	2.4	0.77
	DC 034N001	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	0.01	0.01	0.01	0.00	0.00	0.95	0.61	0.45	0.36
	DC 035P001	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	0.00	0.00	0.00	0.00	0.00	0.25	0.14	0.14	0.09
	DC 035S001	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	0.01	0.01	0.01	0.00	0.00	0.51	0.42	0.30	0.23
	DC 035S002	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	DC 062C001	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	0.00	0.00	0.00	N/A	N/A	0.22	0.09	0.07	N/A
	DC 062C002	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	DC 062D001	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	0.01	0.01	0.01	0.01	0.00	1.37	1.25	0.57	0.51
	DC 062K001	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	DC 062K002	Diversion Chamber	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)	--	Y	0.01	0.00	0.00	0.00	0.00	0.44	0.30	0.21	0.18
	CSO 034R001	Outfall	Ohio River	Sawmill Run Interceptor (O-14)	034R001	--	Y	0.02	0.02	0.02	0.01	0.01	1.29	1.21	0.72	0.68
	CSO 138JO01	Outfall	Sawmill Run	Englert and Weyman Streets		--	Y	0.04	0.01	0.01	0.01	0.01	1.84	0.74	0.6	0.56
	CSO 138P001	Outfall	Sawmill Run	Englert and Weyman Streets		--	Y	0.1	0.02	0.02	0.01	0.01	0.24	0.14	0.14	0.12
	CSO 138K001	Outfall	Sawmill Run	Englert and Weyman Streets	138K001	Y	--	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations
Mon-Ohio	ACSO 012BM17	Outfall	Monongahela River	Arlington through 25th Street	012BM17	--	Y	1.1	0.5	0.01	0	0	3.06	2.14	1.34	1.16
	ACSO 029KM24	Outfall	Monongahela River	Arlington through 25th Street		--	Y	1.37	0.73	0.14	0.08	0.02	3.13	2.37	0.39	0.37
	ACSO 003CM11A	Outfall	Monongahela River	Arlington through 25th Street	003GM11A	Y	--	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations
	CSO 030N001	Outfall	Monongahela River	Becks Run	030N001	--	Y	0.02	0.02	0.01	0.01	0.01	1.43	1.32	1.13	1.04
	CSO 032N001	Outfall	Monongahela River	Becks Run	032N001	--	Y	0.04	0.03	0.03	0.02	0.01	1.99	1.99	1.86	1.21
	CSO 032P001	Outfall	Monongahela River	Becks Run	032P001	Y	--	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations	No Activations
	ACSO 021SO35	Outfall	Ohio River	Pennsylvania Avenue	021SO35	--	Y	0.03	0.03	0.02	0.01	0	2.49	1.63	1.36	1.13
	CSO 184E001	Outfall	Monongahela River	Streets Run	184E001	--	Y	0.54	0.24	0.11	0.04	0.02	28.86	23.23	3.49	1.68
	CSO 185H001	Outfall	Monongahela River	Streets Run	185H001	--	Y	0.13	0.07	0.02	0.02	0.01	1.03	0.89	0.55	0.3
	CSO 134A001	Outfall	Monongahela River	Streets Run	134A001	--	Y	0.16	0.01	0.01	0.01	0	9.86	1.21	0.62	0.35

Table C-2
No Activation, Remote Location and Low Volume Alternative Analysis Results for 4 Overflows Per Year

System	Structure Name	NPDES Permit Number	No Activation Outfall	Remote or Low Volume Outfall	Sewershed Area (Acres)	Peak Volume - MG (4 Overflows)	Peak Flow - MGD (4 Overflows)	Outfall Included in Another Alternative Analysis	Pipe Storage Assumption	Pipe Storage Cost ($)	Sewer Separation Cost ($)
Allegheny North	ACSO 008MA49	008MA49	--	Y	6	0.005	0.04	Consolidation A-49 to A-51 Region O-43 to A-59A Tunnels AN-1, AN-2	100 ft of 42-in pipe	$72,000	$1,244,000
	ACSO 048NA63	048NA63	--	Y	20	0.02	1.14	Region A-60 to A-66 Tunnel AN-2	110 ft of 78-in pipe	$172,000	$4,056,000
	CSO 163G001	163G001	--	Y	21	0.05	0.92	Outfall specific	230 ft of 90-in pipe	$562,000	$3,207,000
Chartiers Creek	ACSO 079FC26A	067FC26A	--	Y	9	0.01	0.63	Consolidation C-26A to C-29 Region C-25 to C-29 Tunnel CC-2	100 ft of 54-in pipe	$95,000	$1,397,000
	CSO 039E001	039E001	--	Y	4	0.01	0.11	Consolidation 039E001 to 068H002 Region Bells Run Tunnel CC-2	100 ft of 60-in pipe	$109,000	$642,000
	CSO 039J001	039J001	--	Y	7	0.005	0.15	Consolidation 039E001 to 068H002 Region Bells Run Tunnel CC-2	110 ft of 42-in pipe	$80,000	$1,095,000
	CSO 068H001	068H001	--	Y	10	0.003	0.34	Consolidation 039E001 to 068H002 Region Bells Run Tunnel CC-2	75 ft of 42-in pipe	$54,000	$1,548,000
Sawmill Run	ACSO 034LS28		--	Y	40	0.003	0.06	Outfall specific Region S-23 to S-29 Tunnels SMR-1a, SMR-1b, SMR-2a, SMR-2b	65 ft of 42-in pipe	$47,000	$6,074,000
	ACSO 019MS42		Y	--	12	0	0	Region S-37 to S-42 Tunnels SMR-1a, SMR-1b, SMR-2a, SMR-2b	NA	NA	NA
	CSO 016A002	016A002	--	Y	42	0.01	1.18	Consolidation CSO 016A002 to 035J001 Region CSO 016A001 to 036R001 Tunnels SMR-1b, SMR-2b	120 ft of 60-in pipe	$127,000	$6,376,000
	CSO 139B003	139B003	--	Y	22	0.01	0.63	Consolidation McDonoughs Tunnels SMR-2a, SMR-2b	100 ft of 60-in pipe	$108,000	$3,358,000
	CSO 139F001	139F001	Y	--	17	0	0	Tunnels SMR-2a, SMR-2b	NA	NA	NA
	ACSO 034BS30		Y	--	5	0	0	Region S-30 to S-36 Tunnels SMR-1a, SMR-1b, SMR-2a, SMR-2b	NA	NA	NA
	ACSO 015JS34			Y	8	0.09	0.77	Region S-30 to S-36 Tunnels SMR-1a, SMR-1b, SMR-2a, SMR-2b	100 ft of 60-in pipe	$106,000	$1,246,000
	DC 034N001	015P001 (Flows to CSO 015P001)	--	Y	8.6	0.004	0.36	No	75 ft of 48-in pipe	$61,000	$1,336,000
	DC 035P001	015P001 (Flows to CSO 015P001)	--	Y	4.1	0.001	0.09	No	30 ft of 36-in pipe	$19,000	$655,000
	DC 035S001	015P001 (Flows to CSO 015P001)	--	Y	3.2	0.003	0.23	No	55 ft of 78-in pipe	$84,000	$522,000
	DC 035S002	Direct Connection to Interceptor	--	--	29.9	NA	NA	No	NA	NA	NA
	DC 062C001	015P001 (Flows to CSO 015P001)	--	Y	5.6	N/A	N/A	No	25 ft of 36-in pipe**	12000**	$884,000
	DC 062C002	015P001 (Flows to CSO 015P001)	Y	--	1.7	N/A	N/A	No	NA	NA	NA
	DC 062D001	015P001 (Flows to CSO 015P001)	--	Y	15.3	0.01	0.51	No	60 ft of 60-in pipe	$64,000	$2,347,000
	DC 062K001	015P001 (Flows to CSO 015P001)	Y	--	2.4	N/A	N/A	No	NA	NA	NA
	DC 062K002	015P001 (Flows to CSO 015P001)	--	Y	4.3	0.001	0.18	No	25 ft of 48-in pipe	$19,000	$688,000
	CSO 034R001	034R001	--	Y	17	0.01	0.68	Outfall specific Region S-18 to CSO 095J001 Tunnels SMR-2a, SMR-2b	100 ft of 60-in pipe	$111,000	$2,604,000
	CSO 138J001		--	Y	10	0.09	0.56	Consolidation Weyman	100 ft of 60-in pipe	$106,000	$1,548,000
	CSO 138P001		--	Y	11	0.01	0.12	Consolidation Weyman	120 ft of 54-in pipe	$117,000	$1,699,000
	CSO 138K001	138K001	Y	--	1	0	0	No	NA	NA	NA
Mon-Ohio	ACSO 012BM17	012BM17	--	Y	8	0.005	1.16	Consolidation M-12 to M-17 Region M-6 to M-17 Tunnels MO-1, MO-2a, MO-2b, MO-3, MO-4, MO-5, MO-6	80 ft of 48-in pipe	$68,000	$1,646,000
	ACSO 029KM24		--	Y	38	0.08	0.37	Consolidation M-18 to M-24 Region M-18 to M-28 Tunnels MO-1, MO-2a, MO-2b, MO-3, MO-4, MO-5, MO-6	350 ft of 90-in pipe	$706,000	$7,672,000
	ACSO 003CM11A	003GM11A	Y	--	2	0	0	No	NA	NA	NA
	CSO 030N001	030N001	--	Y	11	0.01	1.04	Outfall specific	100 ft of 60-in pipe	$111,000	$1,699,000
	CSO 032N001	032N001	--	Y	44	0.02	1.21	Outfall specific	225 ft of 60-in pipe	$243,000	$6,677,000
	CSO 032P001	032P001	Y	--	56	0	0	No	NA	NA	NA
	ACSO 021SO35	021SO35	--	Y	4	0.08	1.13	Consolidation O-35 to O-38 Region O-29 to O-41 Tunnels MO-1, MO-2a, MO-2b, MO-3, MO-4, MO-5, MO-6	100 ft of 54-in pipe	$98,000	$642,000
	CSO 184E001	184E001	--	Y	22	0.04	1.68	Region Streets Run Consolidation CSO 184E001 and 185H001	175 ft of 90-in pipe	$348,000	$3,358,000
	CSO 185H001	185H001	--	Y	35	0.02	0.3	Consolidation CSO 184E001 and 185H001 Region Streets Run	100 ft of 78-in pipe	$158,000	$5,319,000
	CSO 134A001	134A001	--	Y	9	0.02	0.035	Outfall specific Region Streets Run	110 ft of 48-in pipe	$92,000	$1,397,000

* Includes the overflow volume and rates from DC 062D001 in addition to DC 035S001

Appendix F
Subsystem Alternative Cost Analysis Summary

1.0 Introduction

This appendix presents the results of the cost and sizing analysis for the subsystem alternatives for six large regions in the PWSA Service Area. These alternatives include tunnels as the main CSO control component with some outfalls being controlled with regional or outfall specific recommended alternatives. Tunnels were selected as the primary component of the subsystem alternatives because the regional alternative analysis resulted in tunnels as the highest ranked alternative for many of the regions. Because the regional tunnels were evaluated on a region by region basis, duplication of facility costs (such as pump stations) is avoided by assuming that one large tunnel will be used to address a region rather than multiple short tunnels. Therefore, the CSO statistics were combined for a larger scale tunnel costing and sizing analysis for the subsystem alternative analysis.

2.0 Methodology

There are six large regions in the PWSA Service Area that can be served independently by separate subsystems. These regions are: Allegheny North, Allegheny South, Chartiers Creek, Glen Mawr, Sawmill Run, and the largest region, the Monongahela-Ohio Region, which includes the Downtown Monongahela Sewersheds, Second Avenue Sewersheds, Boundary Street Sewershed, Hazelwood Sewersheds, Nine Mile Run Sewershed, Arlington through 25th Sewersheds, Becks Run Sewershed, and Streets Run Sewershed. Different lengths of tunnels were considered for the regions where there were obvious breaking points for construction. For example, the longest tunnel length considered for a region would include all the outfalls along the main river. The next shortest length of tunnel considered for this region would not include the farthest outlying outfalls and only collect overflows from more congested areas. In this case, the outlying outfalls would be controlled by the highest ranked regional or outfall specific alternatives. The names of the tunnel segments that were evaluated and general descriptions of where they would be located are listed below. A more detailed listing of the outfalls that are included in each segment is presented on Tables F-1 through F-6.

Allegheny North:

1. AN-1: Includes A-47 through A-59A
2. AN-2: Includes A-47 through A-66

Allegheny South:

1. AS-1: Includes A-01 through A-37
2. AS-2: Includes A-01 through A-41
3. AS-3: Includes A-01 through A-42

Chartiers Creek:

1. CC-1: Includes C-2 through C-13A
2. CC-2: Includes C-2 through C-29 and Bells Run

Glen Mawr:

1. GM-1: Includes O-8 through O-13

Saw Mill Run:

1. SMR-1:
   a. SMR-1a: Includes O-14 through S-30 without Little Saw Mill Run
   b. SMR-1b: Includes O-14 through S-30 with Little Saw Mill Run
2. SMR-2:
   a. SMR-2a: Includes O-14 to McDonough's Run without Little Saw Mill Run
   b. SMR-2b: Includes O-14 to McDonough's Run with Little Saw Mill Run

Mon-Ohio:

1. MO-1: Includes O-25 through O-43 and M-01 through M-28
2. MO-2: Includes O-25 through O-43 and M-01 through M-29/30
3. MO-3: Includes O-25 through O-43 and M-01 through M-40
4. MO-4: Includes O-25 through O-43 and M-01 through M-42
5. MO-5: Includes O-25 through O-43 and M-01 through M-47
6. MO-6: Includes O-25 through O-43 and M-01 through M-30 and M-46 through M-47

The length of the tunnel segments were assumed to be the length between the outfalls along the Main Rivers or Chartiers Creek or Sawmill Run that are being collected. In a small number of instances, the tunnels are slightly shorter because consolidation pipe was assumed to collect and convey overflows along these streams to the tunnel. Tunnels were not proposed to be constructed along smaller streams such as Bells Run, tributaries to Sawmill Run, Becks Run, Streets Run, or Nine Mile Run. In cases where there are PWSA outfall structures along these smaller streams, it was assumed that consolidation pipes will be constructed to convey these flows to the tunnel. Some outfalls are not included in a tunnel if they are located such that local storage or treatment would be less costly than constructing a consolidation pipe to the connection point with the tunnel. The diameters of the tunnels were sized to assume 80% storage capacity. Consolidation pipes were assumed to have capacity to convey the peak flows for a control level of 0 overflows per year for control levels 0 through 6 for the tunnel. This will ensure that the overflows will only occur when the tunnel reaches capacity, and not when a large peak rate event might occur that would cause additional overflows during the year at individual outfalls. Similarly, drop shafts were also sized to convey flows for a control level of 0 overflows per year.

3.0 Results Summary

For each subsystem alternative, a report has been prepared that presents the results of the alternative evaluation and a summary of the CSO control technologies that are recommended for any outfalls not included in the tunnel. Each report describes the outfalls that will contribute overflows to the tunnel, the length and diameter of the tunnel, and descriptions of consolidation pipes and drop shafts that would be required to convey flow to the tunnel. Site limitations for access shaft and other required facilities construction are discussed. In addition, each report has a location figure identifying the approximate tunnel alignment and drop shaft locations. Details of the recommended

Appendix F
Subsystem Alternative Cost Analysis Summary

CSO control for any outlying outfalls can be found in the technical memoranda for those outfalls.

Tables F-1 through F-6 present a summary of the analysis for each subsystem alternative for a control level of 4 overflows per year.

APPENDIX F – PWSA SYSTEM

F.1 AN – Allegheny North Subsystem

F.2 AS – Allegheny South Subsystem

F.3 MO – Monongahela Ohio Subsystem

F.4 SMR – Sawmill Run Subsystem

F.5 CC – Chartiers Creek Subsystem

F.6 GM – Glen Mawr Subsystem

Objective Scoring

Alternative:	Subsystem	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	5
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	Subsystem	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	4
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Alternative:	Subsystem	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	4
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	Subsystem	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	4
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	Subsystem	Objective Scoring: Constructability	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	3
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	Subsystem	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	3
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	Subsystem	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	4
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Alternative:	Subsystem	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	3
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	Subsystem	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Objective Scoring

Alternative:	Subsystem	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	3.5
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Alternative:	Subsystem	Objective Scoring: Flexibility	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	4
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	Subsystem	Objective Scoring: Reliability	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	5
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	Subsystem	Objective Scoring: Compatibility	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	3
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Alternative:	Region	Objective Scoring: Present Worth	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	5
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	Region	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	3
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Alternative:	Region	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	3.5
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	Region	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	4
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	Region	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	2.5
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	Region	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	3
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	Region	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Alternative:	Region	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	Region	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Objective Scoring

Alternative:	Region	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	3.5
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Alternative:	Region	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	Region	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	4.5
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	Region	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	2.5
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Yellow Box = Objective scores determined by PWSA / Consultant Team
Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	Outfall	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	4
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	Outfall	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	2
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Alternative:	Outfall	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	3
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	Outfall	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	2.5
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	Outfall	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	1.5
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	Outfall	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	2
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	Outfall	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	1
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Alternative:	Outfall	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	3
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	Outfall	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Objective Scoring

Alternative:	Outfall	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	4.5
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Alternative:	Outfall	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	1
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	Outfall	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	5
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	Outfall	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	4
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Yellow Box = Objective scores determined by PWSA / Consultant Team
Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Total Scores

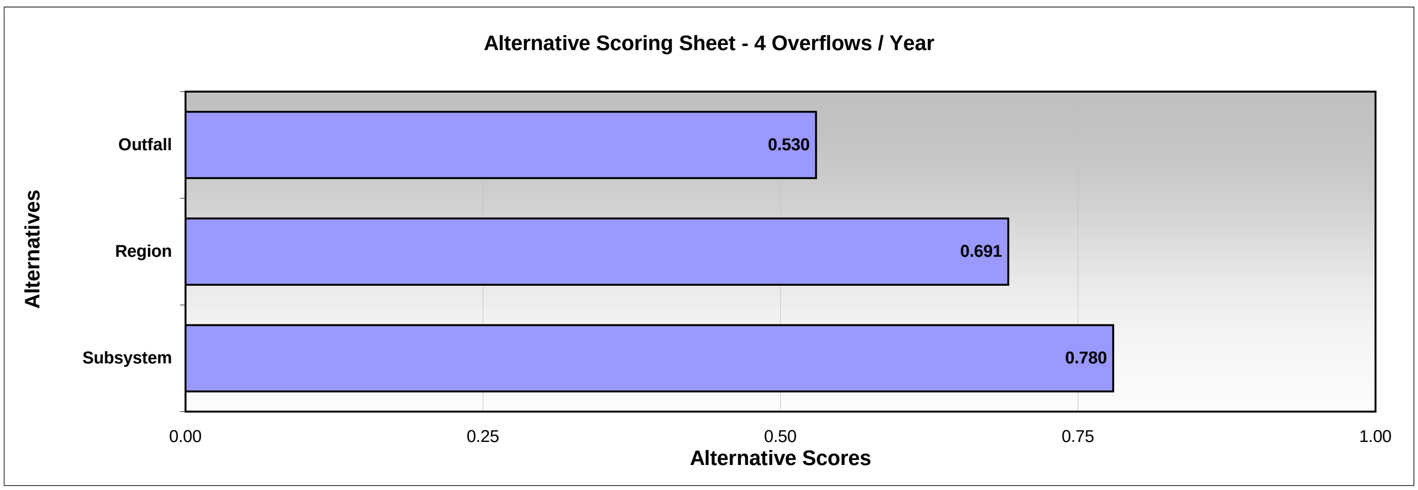
Alternative:	Subsystem		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	4	0.75	0.053	0.040
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3.5	0.64	0.078	0.050
Flexibility	4	0.75	0.053	0.040
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	4	0.75	0.128	0.096
			Sum Total:	**0.780**

Total Scores

Alternative:	Region		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3.5	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	2.5	0.31	0.062	0.019
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3.5	0.64	0.078	0.050
Flexibility	3	0.50	0.053	0.027
Reliability	4.5	0.88	0.102	0.089
Compatibility	2.5	0.38	0.042	0.016
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.691**

Total Scores

Alternative:	Outfall		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	4	0.75	0.147	0.110
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	2.5	0.31	0.108	0.034
Constructability	1.5	0.04	0.062	0.002
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	1	0.00	0.053	0.000
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4.5	0.95	0.078	0.074
Flexibility	1	0.00	0.053	0.000
Reliability	5	1.00	0.102	0.102
Compatibility	4	0.75	0.042	0.032
Annual O&M	2	0.25	0.128	0.032
			Sum Total:	**0.530**


Alternative Scoring Sheet - 4 Overflows / Year
Alternatives
Outfall
Region
Subsystem
0.530
0.691
0.780
0.00
0.25
0.50
0.75
1.00
Alternative Scores

Cost Summary

PW COST (MM$)		
Subsystem	$	1,576.01
Region	$	1,621.09
Outfall	$	1,769.25
MINIMUM	**$**	**1,576.01**

PW COST SCORES	
Subsystem	5
Region	5
Outfall	4

5 => Within 110% of Lowest PW Cost Alternative
4 => 110% to 120% of Lowest PW Cost Alternative
3 => 120% to 130% of Lowest PW Cost Alternative
2 => 130% to 140% of Lowest PW Cost Alternative
1 => Above 140% of Lowest PW Cost Alternative

ANNUAL O&M (MM$)		
Subsystem	$	12.90
Region	$	15.84
Outfall	$	17.28
AVERAGE	**$**	**15.34**

O&M COST SCORES	
Subsystem	4
Region	3
Outfall	2

5 => Within +/-10% of the average Annual O&M Cost for all Alternatives
4 => +/-10% to +/-20% of the average Annual O&M Cost for all Alternatives
3 => +/-20% to +/-30% of the average Annual O&M Cost for all Alternatives
2 => +/-30% to +/-40% of the average Annual O&M Cost for all Alternatives
1 => Greater than +/-40% of the average Annual O&M Cost for all Alternatives

Cost Summary

SUBSYSTEM[1]	CAPITAL COST (MM$)	PW COST (MM$)	ANNUAL O&M (MM$)
AN-2	157.4	176.4	1.7
AS-3	392.7	441.9	4.4
SMR-2B	251.8	269.0	1.5
CC-3	169.9	182.8	1.1
MO-5	458.5	505.9	4.2
TOTAL COST (MM$)	**1430.4**	**1576.0**	**12.9**

REGION[1]	CAPITAL COST (MM$)	PW COST (MM$)	ANNUAL O&M (MM$)
Allegheny North	129.4	149.1	1.7
Allegheny South	402.0	463.1	5.3
Chartiers	121.8	133.8	1.0
Glen Mawr	50.6	57.2	0.5
Saw Mill Run	210.3	230.8	1.7
Mon-Ohio	523.2	587.1	5.6
TOTAL COST (MM$)	**1437.3**	**1621.1**	**15.8**

:s

Cost Summary

OUTFALL AREAS	CAPITAL COST (MM$)	PW COST (MM$)	ANNUAL O&M (MM$)
Allegheny North	$ 169.2	$ 191.3	$ 1.9
Allegheny South	$ 456.5	$ 521.2	$ 5.4
Chartiers	$ 121.3	$ 137.1	$ 1.3
Glen Mawr	$ 53.4	$ 59.6	$ 0.5
Saw Mill Run	$ 195.0	$ 225.4	$ 2.6
Mon-Ohio	$ 572.3	$ 634.7	$ 5.5
TOTAL COST (MM$)	**$ 1,567.8**	**$ 1,769.3**	**$ 17.3**

[1] Stored volume treatment only accounted for in Subsystem and Regional analyses

[2] Highest rated alternatives were all sewer separation which has an Annual O&M of $0

Table F-1
Allegheny North Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 008LA47	Allegheny River	Dasher Street (Allegheny)	008LA47	AN-1	Tunnel	12.25	--	1.4	18.5	$81.1
ACSO 008LA48	Allegheny River	Dasher Street (Allegheny)	008LA48							
ACSO 008MA49	Allegheny River	Dasher Street (Allegheny)	008MA49							
ACSO 008MA50	Allegheny River	Dasher Street (Allegheny)	008MA50							
ACSO 008MA51	Allegheny River	East Street	008MA51							
ACSO 009EA56	Allegheny River	East Street	009EA56							
ACSO 009EA58	Allegheny River	East Street	009EA58							
ACSO 009BA59	Allegheny River	East Street	009BA59							
ACSO 009BA59A	Allegheny River	East Street	009BA59A							
CSO 009E001	Allegheny River	East Street	009E001							
ACSO 024RA60	Allegheny River	Spring Garden	024RA60		Screening & Disinfection	20.66	141.91	-	-	$61.4
ACSO 024LA61	Allegheny River	Spring Garden	024LA61							
ACSO 025AA62	Allegheny River	Spring Garden	025AA62							
ACSO 048NA63	Allegheny River	Spring Garden	048NA63							
ACSO 048NA64	Allegheny River	Spring Garden	048NA64							
ACSO 048FA65	Allegheny River	Spring Garden	048FA65							
ACSO 048FA66	Allegheny River	Spring Garden	048FA66							
CSO 163G001	Allegheny River	East Street	163G001		Remote/Low Flow (Sewer Separation)	0.05	0.92	-	-	$3.2
								TOTAL COST (Million $)		$145.7

Table F-1
Allegheny North Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 008LA47	Allegheny River	Dasher Street (Allegheny)	008LA47	AN-2	Tunnel	30.14	--	2.9	20.5	$173.20
ACSO 008LA48	Allegheny River	Dasher Street (Allegheny)	008LA48							
ACSO 008MA49	Allegheny River	Dasher Street (Allegheny)	008MA49							
ACSO 008MA50	Allegheny River	Dasher Street (Allegheny)	008MA50							
ACSO 008MA51	Allegheny River	East Street	008MA51							
ACSO 009EA56	Allegheny River	East Street	009EA56							
ACSO 009EA58	Allegheny River	East Street	009EA58							
ACSO 009BA59	Allegheny River	East Street	009BA59							
ACSO 009BA59A	Allegheny River	East Street	009BA59A							
CSO 009E001	Allegheny River	East Street	009E001							
ACSO 024RA60	Allegheny River	Spring Garden	024RA60							
ACSO 024LA61	Allegheny River	Spring Garden	024LA61							
ACSO 025AA62	Allegheny River	Spring Garden	025AA62							
ACSO 048NA63	Allegheny River	Spring Garden	048NA63							
ACSO 048NA64	Allegheny River	Spring Garden	048NA64							
ACSO 048FA65	Allegheny River	Spring Garden	048FA65							
ACSO 048FA66	Allegheny River	Spring Garden	048FA66							
CSO 163G001	Allegheny River	East Street	163G001		Remote/Low Flow (Sewer Separation)	0.05	0.92	-	-	$3.20
								TOTAL COST (Million $)		$176.40

Table F-2
Allegheny South Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ADC008PA01	Allegheny River	Barbeau Street	008PA01	AS-1	Tunnel AS-1	45.6	N/A	5.1	19	$280.8
ADC008RA02	Allegheny River	Fancourt Street	008RA02							
ADC008RA03	Allegheny River	Evans Way	008RA03							
ADC008RA04	Allegheny River	Stanwix Street	008RA04							
ADC008RA05	Allegheny River	Cecil Place	008RA05							
ADC008SA06	Allegheny River	Sixth Street	008RA06							
ADC008SA07	Allegheny River	Barkers Place	008SA07							
ADC008SA08	Allegheny River	Scott Place	008SA08							
ADC008SA09	Allegheny River	Seventh Street	008SA09							
ADC008SA10	Allegheny River	Eighth Street	008SA10							
ADC009JA11	Allegheny River	Ninth Street	009JA11							
ADC009JA12	Allegheny River	Garrison Place	009JA12							
ADC009JA13	Allegheny River	10th Street	009JA13							
ADC009KA14Z	Allegheny River	11th Street	009JA13A							
ADC009KA14	Allegheny River	12th Street	009KA14							
ADC009KA14A	Allegheny River	13th Street	009FA14A							
ADC009FA15	Allegheny River	14th Street	009FA15							
ADC009CA16	Allegheny River	17th Street	009CA16							
ADC024SA17	Allegheny River	20th Street	024SA17							
ADC024SA17A	Allegheny River	22nd Street	024SA17A							
ADC024SA17B	Allegheny River	23rd Street	024SA17B							
ADC025JA18	Allegheny River	24th Street	024MA18							
ADC025JA18A	Allegheny River	25th Street	025JA18A							
ADC025JA18B	Allegheny River	26th Street	025JA18B							
ADC025EA19	Allegheny River	27th Street	025EA19							
ADC025FA19A	Allegheny River	28th Street	025FA19A							
ADC025BA19B	Allegheny River	29th Street	025BA19B							
ADC025BA20	Allegheny River	30th Street	025BA20							
ADC025BA21	Allegheny River	31st Street	048PA21							
ADC048RA22	Allegheny River	32nd Street	048RA22							
ADC048RA23	Allegheny River	33rd Street	048LA23							
ADC048MA25	Allegheny River	36th Street	048GA25							
ADC048HA26	Allegheny River	38th Street	048DA26							
ADC049AA27	Allegheny River	40th Street	048DA27							
Unnamed	Allegheny River	40th Street	N/A							
ADC080NA28	Allegheny River	43rd Street	080NA28							
ADC080FA29	Allegheny River	48th Street	080EA29							
ADC080FA29A	Allegheny River	48th Street	080BA29A							
ADC080BA30	Allegheny River	51st Street	080BA30							
ADC119RA31	Allegheny River	52nd Street	119RA31							
ADC119RA32	Allegheny River	McCandless Street	119RA32							
ADC119MA33	Allegheny River	54th Street	119MA33							
ADC119MA34	Allegheny River	55th Street	119MA34							
ADC120EA35	Allegheny River	57th Street	120EA35							
ADC120CA36	Allegheny River	62nd Street	120CA36							
ADC120DA37	Allegheny River	Voltz Way	120DA37							
ADC120DA37A	Allegheny River	Voltz Way	120DA37A							
ADC121AA38	Allegheny River	Gatewood Way	121AA38		Heth's Run Region: Integrated Outfalls	11.8	122.3	N/A	N/A	$53.5
ADC121CA40	Allegheny River	Chislett Street	121CA40							
ADC121HA41	Allegheny River	Heth's Run	121HA41							
DC121L001	Allegheny River	Highland Park Zoo parking Area	121H001							
ADC122PA42	Allegheny River	A-42 & A-42A Negley Run Sewershed	122EA42		Negley Run Region: Screening & Disinfection	26.8	320.5	N/A	N/A	$85.9
								TOTAL COST (Million $)		$420.2

Table F-2
Allegheny South Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ADC008PA01	Allegheny River	Barbeau Street	008PA01							
ADC008RA02	Allegheny River	Fancourt Street	008RA02							
ADC008RA03	Allegheny River	Evans Way	008RA03							
ADC008RA04	Allegheny River	Stanwix Street	008RA04							
ADC008RA05	Allegheny River	Cecil Place	008RA05							
ADC008SA06	Allegheny River	Sixth Street	008RA06							
ADC008SA07	Allegheny River	Barkers Place	008SA07							
ADC008SA08	Allegheny River	Scott Place	008SA08							
ADC008SA09	Allegheny River	Seventh Street	008SA09							
ADC008SA10	Allegheny River	Eighth Street	008SA10							
ADC009JA11	Allegheny River	Ninth Street	009JA11							
ADC009JA12	Allegheny River	Garrison Place	009JA12							
ADC009JA13	Allegheny River	10th Street	009JA13							
ADC009KA14Z	Allegheny River	11th Street	009JA13A							
ADC009KA14	Allegheny River	12th Street	009KA14							
ADC009KA14A	Allegheny River	13th Street	009FA14A							
ADC009FA15	Allegheny River	14th Street	009FA15							
ADC009CA16	Allegheny River	17th Street	009CA16							
ADC024SA17	Allegheny River	20th Street	024SA17							
ADC024SA17A	Allegheny River	22nd Street	024SA17A							
ADC024SA17B	Allegheny River	23rd Street	024SA17B							
ADC025JA18	Allegheny River	24th Street	024MA18							
ADC025JA18A	Allegheny River	25th Street	025JA18A							
ADC025JA18B	Allegheny River	26th Street	025JA18B							
ADC025EA19	Allegheny River	27th Street	025EA19							
ADC025FA19A	Allegheny River	28th Street	025FA19A	AS-2	Tunnel AS-2	58.5	N/A	6.0	20	$340.3
ADC025BA19B	Allegheny River	29th Street	025BA19B							
ADC025BA20	Allegheny River	30th Street	025BA20							
ADC025BA21	Allegheny River	31st Street	048PA21							
ADC048RA22	Allegheny River	32nd Street	048RA22							
ADC048RA23	Allegheny River	33rd Street	048LA23							
ADC048MA25	Allegheny River	36th Street	048GA25							
ADC048HA26	Allegheny River	38th Street	048DA26							
ADC049AA27	Allegheny River	40th Street	048DA27							
Unnamed	Allegheny River	40th Street	N/A							
ADC080NA28	Allegheny River	43rd Street	080NA28							
ADC080FA29	Allegheny River	48th Street	080EA29							
ADC080FA29A	Allegheny River	48th Street	080BA29A							
ADC080BA30	Allegheny River	51st Street	080BA30							
ADC119RA31	Allegheny River	52nd Street	119RA31							
ADC119RA32	Allegheny River	McCandless Street	119RA32							
ADC119MA33	Allegheny River	54th Street	119MA33							
ADC119MA34	Allegheny River	55th Street	119MA34							
ADC120EA35	Allegheny River	57th Street	120EA35							
ADC120CA36	Allegheny River	62nd Street	120CA36							
ADC120DA37	Allegheny River	Voltz Way	120DA37							
ADC120DA37A	Allegheny River	Voltz Way	120DA37A							
ADC121AA38	Allegheny River	Gatewood Way	121AA38							
ADC121CA40	Allegheny River	Chislett Street	121CA40							
ADC121HA41	Allegheny River	Heth's Run	121HA41							
DC121L001	Allegheny River	Highland Park Zoo parking Area	121H001							
ADC122PA42	Allegheny River	A-42 & A-42A Negley Run Sewershed	122EA42		Negley Run Region: Screening & Disinfection	26.8	320.5	N/A	N/A	$85.9
								TOTAL COST (Million $)		$426.2

Table F-2
Allegheny South Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ADC008PA01	Allegheny River	Barbeau Street	008PA01	AS-3	Tunnel AS-3	84.3	N/A	6.6	23	$441.9
ADC008RA02	Allegheny River	Fancourt Street	008RA02							
ADC008RA03	Allegheny River	Evans Way	008RA03							
ADC008RA04	Allegheny River	Stanwix Street	008RA04							
ADC008RA05	Allegheny River	Cecil Place	008RA05							
ADC008SA06	Allegheny River	Sixth Street	008RA06							
ADC008SA07	Allegheny River	Barkers Place	008SA07							
ADC008SA08	Allegheny River	Scott Place	008SA08							
ADC008SA09	Allegheny River	Seventh Street	008SA09							
ADC008SA10	Allegheny River	Eighth Street	008SA10							
ADC009JA11	Allegheny River	Ninth Street	009JA11							
ADC009JA12	Allegheny River	Garrison Place	009JA12							
ADC009JA13	Allegheny River	10th Street	009JA13							
ADC009KA14Z	Allegheny River	11th Street	009JA13A							
ADC009KA14	Allegheny River	12th Street	009KA14							
ADC009KA14A	Allegheny River	13th Street	009FA14A							
ADC009FA15	Allegheny River	14th Street	009FA15							
ADC009CA16	Allegheny River	17th Street	009CA16							
ADC024SA17	Allegheny River	20th Street	024SA17							
ADC024SA17A	Allegheny River	22nd Street	024SA17A							
ADC024SA17B	Allegheny River	23rd Street	024SA17B							
ADC025JA18	Allegheny River	24th Street	024MA18							
ADC025JA18A	Allegheny River	25th Street	025JA18A							
ADC025JA18B	Allegheny River	26th Street	025JA18B							
ADC025EA19	Allegheny River	27th Street	025EA19							
ADC025FA19A	Allegheny River	28th Street	025FA19A							
ADC025BA19B	Allegheny River	29th Street	025BA19B							
ADC025BA20	Allegheny River	30th Street	025BA20							
ADC025BA21	Allegheny River	31st Street	048PA21							
ADC048RA22	Allegheny River	32nd Street	048RA22							
ADC048RA23	Allegheny River	33rd Street	048LA23							
ADC048MA25	Allegheny River	36th Street	048GA25							
ADC048HA26	Allegheny River	38th Street	048DA26							
ADC049AA27	Allegheny River	40th Street	048DA27							
Unnamed	Allegheny River	40th Street	N/A							
ADC080NA28	Allegheny River	43rd Street	080NA28							
ADC080FA29	Allegheny River	48th Street	080EA29							
ADC080FA29A	Allegheny River	48th Street	080BA29A							
ADC080BA30	Allegheny River	51st Street	080BA30							
ADC119RA31	Allegheny River	52nd Street	119RA31							
ADC119RA32	Allegheny River	McCandless Street	119RA32							
ADC119MA33	Allegheny River	54th Street	119MA33							
ADC119MA34	Allegheny River	55th Street	119MA34							
ADC120EA35	Allegheny River	57th Street	120EA35							
ADC120CA36	Allegheny River	62nd Street	120CA36							
ADC120DA37	Allegheny River	Voltz Way	120DA37							
ADC120DA37A	Allegheny River	Voltz Way	120DA37A							
ADC121AA38	Allegheny River	Gatewood Way	121AA38							
ADC121CA40	Allegheny River	Chislett Street	121CA40							
ADC121HA41	Allegheny River	Heth's Run	121HA41							
DC121L001	Allegheny River	Highland Park Zoo parking Area	121H001							
ADC122PA42	Allegheny River	A-42 & A-42A Negley Run Sewershed	122EA42							
								TOTAL COST (Million $)		$441.9

Table F-3
Monongahela - Ohio Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North / South / East Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Vol - MG (4 Overflows)	Peak Flow Rate MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
O25	Ohio River	Jacks Run	0	MO-1	Tunnel MO-1	34.2	N/A	2.4	24	$295.9
O26	Ohio River	Jacks Run	075AO26							
O27	Ohio River	Woods Run	044BO27							
O29	Ohio River	Doerr, Superior, and Island	044RO29							
O30	Ohio River	Doerr, Superior, and Island	021DO30							
O31	Ohio River	Adams Street	021HO31							
O32	Ohio River	Adams Street	021HO32							
O33	Ohio River	Adams Street	021MO33							
O34	Ohio River	Adams Street	021MO34							
O35	Ohio River	Pennsylvania Avenue	021SO35							
O36	Ohio River	Pennsylvania Avenue	021SO36							
O37	Ohio River	Pennsylvania Avenue	007AO37							
O38	Ohio River	Pennsylvania Avenue	007AO38							
O39	Ohio River	Pennsylvania Avenue	007EO39							
O40	Ohio River	Pennsylvania Avenue	007KO40							
O41	Ohio River	Pennsylvania Avenue	007KO41							
O43	Ohio River	Dasher Street	007MO43							
M01	Monongahela River	Commonwealth Place	001FM01							
M02	Monongahela River	Stanwix Street	001LM02							
M03	Monongahela River	Wood Street	001MM03							
M03A	Monongahela River	Cherry Way	001MM03A							
M04	Monongahela River	Grant Street	001SM04							
M05	Monongahela River	Try Street	002NM05							
M06	Monongahela River	Arlington through 25th Street	003AM06							
M07	Monongahela River	Arlington through 25th Street	003BM07							
M08	Monongahela River	Arlington through 25th Street	003BM08							
M10	Monongahela River	Arlington through 25th Street	003CM10							
M11	Monongahela River	Arlington through 25th Street	003CM11							
M12	Monongahela River	Arlington through 25th Street	003DM12							
M13	Monongahela River	Arlington through 25th Street	003DM13							
M14	Monongahela River	Arlington through 25th Street	012AM14							
M14A	Monongahela River	Arlington through 25th Street	012AM14A							
M15	Monongahela River	Arlington through 25th Street	012AM15							
M16	Monongahela River	Arlington through 25th Street	012BM16							
M17	Monongahela River	Arlington through 25th Street	012BM17							
M11A	Monongahela River	Arlington through 25th Street	003GM11A							
M19	Monongahela River	Brady Street	011RM19							
M19A	Monongahela River	M-19A Maurice Street	011SM19B							
M19BCD	Monongahela River	M-19B; M-19C & M-19D Bates Street	029FM19A							
M18	Monongahela River	Arlington through 25th Street	012CM18							
M20	Monongahela River	Arlington through 25th Street	012CM20							
M21	Monongahela River	Arlington through 25th Street	012DM21							
M22	Monongahela River	Arlington through 25th Street	012DM22							
M23	Monongahela River	Arlington through 25th Street	012HM23							
M24	Monongahela River	Arlington through 25th Street								
M26	Monongahela River	Arlington through 25th Street	029KM26							
M27	Monongahela River	Arlington through 25th Street	029PM27							
M28	Monongahela River	Arlington through 25th Street								
M29	Monongahela River	Greenfield Avenue	029RM29		Boundary Street Region: Surface Storage Tank	21.4	314.3	N/A	N/A	$111.3
M31	Monongahela River	Rutherglen St.	030MM31		Hazelwood Region: Tunnel Storage	0.08	6.9	N/A	N/A	$51.1
M31A	Monongahela River	Rutherglen St.	030MM31A			#N/A	#N/A			
M32	Monongahela River	Tullymet Street	031DM32			0.05	3.2			
M33	Monongahela River	Longworth Street	031HM33			0.07	2.5			
M35	Monongahela River	Hazelwood Avenue Sewershed	031HM35			1.61	21.9			
M36	Monongahela River	Tecumseh Street	031MM36			1.86	34.9			
M37	Monongahela River	Melanchton Street	057AM37			0.14	4.8			
M38	Monongahela River	Vespucius Street	057KM38			0.01	0.8			
M39	Monongahela River	Renova Street	057KM39			0.08	2.4			
M40	Monongahela River	Alluvian Street	057MM40			0.46	20.2			
CSO 032P001	Monongahela River	Becks Run	032P001		No Activation	0.0	0.0	N/A	N/A	$0.0
M34	Monongahela River	Becks Run	031GM34		Surface Storage Tank	6.1	21.9	N/A	N/A	$16.0
CSO 184E001	Monongahela River	Streets Run	184E001		Screen and Disinfection	7.8	20.0	N/A	N/A	$22.9
CSO 185H001	Monongahela River	Streets Run	185H001							
CSO 134A001	Monongahela River	Streets Run	134A001							
M42	Monongahela River	Streets Run	0							
M47	Monongahela River	Nine Mile Run	129NM47		Nine Mile Run Region: Screening & Disinfection	9.5	19.0	N/A	N/A	$10.6
SPS089C001	Monongahela River	Homestead Bridge	089D001							
DC129B001	Nine Mile Run	Swisshelm Park	129B001		Nine Mile Run - Frick Park Region: Sub Surface Storage	0.4	5.4	N/A	N/A	$9.5
128R002	Nine Mile Run	Nine Mile Run - Frick Park	128R002							
177K001	Nine Mile Run	Upper Nine Mile Run	177K001		Upper Nine Mile Run Region: Sub Surface Storage Tank	0.7	27.4	N/A	N/A	$8.0
CSO 030N001	Monongahela River	Becks Run	030N001		Sewer Separation	0.01	1.04	N/A	N/A	$1.7
CSO 032N001	Monongahela River	Becks Run	032N001		Sub-Surface Storage Tank	0.02	1.21	N/A	N/A	$2.3
								TOTAL COST (Million $)		$531.4

Table F-3
Monongahela - Ohio Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North / South / East Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Vol - MG (4 Overflows)	Peak Flow Rate MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
O25	Ohio River	Jacks Run	0	MO-2	Tunnel MO-2	52.2	N/A	2.9	27	$367.0
O26	Ohio River	Jacks Run	075AO26							
O27	Ohio River	Woods Run	044BO27							
O29	Ohio River	Doerr, Superior, and Island	044RO29							
O30	Ohio River	Doerr, Superior, and Island	021DO30							
O31	Ohio River	Adams Street	021HO31							
O32	Ohio River	Adams Street	021HO32							
O33	Ohio River	Adams Street	021MO33							
O34	Ohio River	Adams Street	021MO34							
O35	Ohio River	Pennsylvania Avenue	021SO35							
O36	Ohio River	Pennsylvania Avenue	021SO36							
O37	Ohio River	Pennsylvania Avenue	007AO37							
O38	Ohio River	Pennsylvania Avenue	007AO38							
O39	Ohio River	Pennsylvania Avenue	007EO39							
O40	Ohio River	Pennsylvania Avenue	007KO40							
O41	Ohio River	Pennsylvania Avenue	007KO41							
O43	Ohio River	Dasher Street	007MO43							
M01	Monongahela River	Commonwealth Place	001FM01							
M02	Monongahela River	Stanwix Street	001LM02							
M03	Monongahela River	Wood Street	001MM03							
M03A	Monongahela River	Cherry Way	001MM03A							
M04	Monongahela River	Grant Street	001SM04							
M05	Monongahela River	Try Street	002NM05							
M06	Monongahela River	Arlington through 25th Street	003AM06							
M07	Monongahela River	Arlington through 25th Street	003BM07							
M08	Monongahela River	Arlington through 25th Street	003BM08							
M10	Monongahela River	Arlington through 25th Street	003CM10							
M11	Monongahela River	Arlington through 25th Street	003CM11							
M12	Monongahela River	Arlington through 25th Street	003DM12							
M13	Monongahela River	Arlington through 25th Street	003DM13							
M14	Monongahela River	Arlington through 25th Street	012AM14							
M14A	Monongahela River	Arlington through 25th Street	012AM14A							
M15	Monongahela River	Arlington through 25th Street	012AM15							
M16	Monongahela River	Arlington through 25th Street	012BM16							
M17	Monongahela River	Arlington through 25th Street	012BM17							
M11A	Monongahela River	Arlington through 25th Street	003GM11A							
M19	Monongahela River	Brady Street	011RM19							
M19A	Monongahela River	M-19A Maurice Street	011SM19B							
M19BCD	Monongahela River	M-19B; M-19C & M-19D Bates Street	029FM19A							
M18	Monongahela River	Arlington through 25th Street	012CM18							
M20	Monongahela River	Arlington through 25th Street	012CM20							
M21	Monongahela River	Arlington through 25th Street	012DM21							
M22	Monongahela River	Arlington through 25th Street	012DM22							
M23	Monongahela River	Arlington through 25th Street	012HM23							
M24	Monongahela River	Arlington through 25th Street								
M26	Monongahela River	Arlington through 25th Street	029KM26							
M27	Monongahela River	Arlington through 25th Street	029PM27							
M28	Monongahela River	Arlington through 25th Street								
M29	Monongahela River	Greenfield Avenue	029RM29							
M31	Monongahela River	Rutherglen St.	030MM31		Hazelwood Region: Tunnel Storage	0.08	6.9	N/A	N/A	$51.1
M31A	Monongahela River	Rutherglen St.	030MM31A			#N/A	#N/A			
M32	Monongahela River	Tullymet Street	031DM32			0.05	3.2			
M33	Monongahela River	Longworth Street	031HM33			0.07	2.5			
M35	Monongahela River	Hazelwood Avenue Sewershed	031HM35			1.61	21.9			
M36	Monongahela River	Tecumseh Street	031MM36			1.86	34.9			
M37	Monongahela River	Melanchton Street	057AM37			0.14	4.8			
M38	Monongahela River	Vespucius Street	057KM38			0.01	0.8			
M39	Monongahela River	Renova Street	057KM39			0.08	2.4			
M40	Monongahela River	Alluvian Street	057MM40			0.46	20.2			
CSO 032P001	Monongahela River	Becks Run	032P001		No Activation	0.0	0.0	N/A	N/A	$0.0
M34	Monongahela River	Becks Run	031GM34		Surface Storage Tank	6.1	21.9	N/A	N/A	$16.0
CSO 184E001	Monongahela River	Streets Run	184E001		Screen and Disinfection	7.8	20.0	N/A	N/A	$22.9
CSO 185H001	Monongahela River	Streets Run	185H001							
CSO 134A001	Monongahela River	Streets Run	134A001							
M42	Monongahela River	Streets Run	0							
M47	Monongahela River	Nine Mile Run	129NM47		Nine Mile Run Region: Screening & Disinfection	9.5	19.0	N/A	N/A	$10.6
SPS089C001	Monongahela River	Homestead Bridge	089D001							
DC129B001	Nine Mile Run	Swisshelm Park	129B001		Nine Mile Run - Frick Park Region: Sub Surface Storage	0.4	5.4	N/A	N/A	$9.5
128R002	Nine Mile Run	Nine Mile Run - Frick Park	128R002							
177K001	Nine Mile Run	Upper Nine Mile Run	177K001		Upper Nine Mile Run Region: Sub Surface Storage Tank	0.7	27.4	N/A	N/A	$8.0
CSO 030N001	Monongahela River	Becks Run	030N001		Sewer Separation	0.01	1.04	N/A	N/A	$1.7
CSO 032N001	Monongahela River	Becks Run	032N001		Sub-Surface Storage Tank	0.02	1.21	N/A	N/A	$2.3
								TOTAL COST (Million $)		$491.3

Table F-3
Monongahela - Ohio Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North / South / East Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Vol - MG (4 Overflows)	Peak Flow Rate MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
O25	Ohio River	Jacks Run	0	MO-3	Tunnel MO-3	60.5	N/A	5.4	21	$409.9
O26	Ohio River	Jacks Run	075AO26							
O27	Ohio River	Woods Run	044BO27							
O29	Ohio River	Doerr, Superior, and Island	044RO29							
O30	Ohio River	Doerr, Superior, and Island	021DO30							
O31	Ohio River	Adams Street	021HO31							
O32	Ohio River	Adams Street	021HO32							
O33	Ohio River	Adams Street	021MO33							
O34	Ohio River	Adams Street	021MO34							
O35	Ohio River	Pennsylvania Avenue	021SO35							
O36	Ohio River	Pennsylvania Avenue	021SO36							
O37	Ohio River	Pennsylvania Avenue	007AO37							
O38	Ohio River	Pennsylvania Avenue	007AO38							
O39	Ohio River	Pennsylvania Avenue	007EO39							
O40	Ohio River	Pennsylvania Avenue	007KO40							
O41	Ohio River	Pennsylvania Avenue	007KO41							
O43	Ohio River	Dasher Street	007MO43							
M01	Monongahela River	Commonwealth Place	001FM01							
M02	Monongahela River	Stanwix Street	001LM02							
M03	Monongahela River	Wood Street	001MM03							
M03A	Monongahela River	Cherry Way	001MM03A							
M04	Monongahela River	Grant Street	001SM04							
M05	Monongahela River	Try Street	002NM05							
M06	Monongahela River	Arlington through 25th Street	003AM06							
M07	Monongahela River	Arlington through 25th Street	003BM07							
M08	Monongahela River	Arlington through 25th Street	003BM08							
M10	Monongahela River	Arlington through 25th Street	003CM10							
M11	Monongahela River	Arlington through 25th Street	003CM11							
M12	Monongahela River	Arlington through 25th Street	003DM12							
M13	Monongahela River	Arlington through 25th Street	003DM13							
M14	Monongahela River	Arlington through 25th Street	012AM14							
M14A	Monongahela River	Arlington through 25th Street	012AM14A							
M15	Monongahela River	Arlington through 25th Street	012AM15							
M16	Monongahela River	Arlington through 25th Street	012BM16							
M17	Monongahela River	Arlington through 25th Street	012BM17							
M11A	Monongahela River	Arlington through 25th Street	003GM11A							
M19	Monongahela River	Brady Street	011RM19							
M19A	Monongahela River	M-19A Maurice Street	011SM19B							
M19BCD	Monongahela River	M-19B; M-19C & M-19D Bates Street	029FM19A							
M18	Monongahela River	Arlington through 25th Street	012CM18							
M20	Monongahela River	Arlington through 25th Street	012CM20							
M21	Monongahela River	Arlington through 25th Street	012DM21							
M22	Monongahela River	Arlington through 25th Street	012DM22							
M23	Monongahela River	Arlington through 25th Street	012HM23							
M24	Monongahela River	Arlington through 25th Street								
M26	Monongahela River	Arlington through 25th Street	029KM26							
M27	Monongahela River	Arlington through 25th Street	029PM27							
M28	Monongahela River	Arlington through 25th Street								
M29	Monongahela River	Greenfield Avenue	029RM29							
M31	Monongahela River	Rutherglen St.	030MM31							
M31A	Monongahela River	Rutherglen St.	030MM31A							
M32	Monongahela River	Tullymet Street	031DM32							
M33	Monongahela River	Longworth Street	031HM33							
M35	Monongahela River	Hazelwood Avenue Sewershed	031HM35							
M36	Monongahela River	Tecumseh Street	031MM36							
M37	Monongahela River	Melanchton Street	057AM37							
M38	Monongahela River	Vespucius Street	057KM38							
M39	Monongahela River	Renova Street	057KM39							
M40	Monongahela River	Alluvian Street	057MM40							
CSO 032P001	Monongahela River	Becks Run	032P001							
M34	Monongahela River	Becks Run	031GM34							
CSO 184E001	Monongahela River	Streets Run	184E001		Screen and Disinfection	7.8	20.0	N/A	N/A	$22.9
CSO 185H001	Monongahela River	Streets Run	185H001							
CSO 134A001	Monongahela River	Streets Run	134A001							
M42	Monongahela River	Streets Run	0							
M47	Monongahela River	Nine Mile Run	129NM47		Nine Mile Run Region: Screening & Disinfection	9.5	19.0	N/A	N/A	$10.6
SPS089C001	Monongahela River	Homestead Bridge	089D001							
DC129B001	Nine Mile Run	Swisshelm Park	129B001		Nine Mile Run - Frick Park Region: Sub Surface Storage	0.4	5.4	N/A	N/A	$9.5
128R002	Nine Mile Run	Nine Mile Run - Frick Park	128R002							
177K001	Nine Mile Run	Upper Nine Mile Run	177K001		Upper Nine Mile Run Region: Sub Surface Storage Tank	0.7	27.4	N/A	N/A	$8.0
CSO 030N001	Monongahela River	Becks Run	030N001		Sewer Separation	0.0	1.0	N/A	N/A	$1.7
CSO 032N001	Monongahela River	Becks Run	032N001		Sub-Surface Storage Tank	0.0	1.2	N/A	N/A	$2.3
								TOTAL COST (Million $)		$467.0

Table F-3
Monongahela - Ohio Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North / South / East Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Vol - MG (4 Overflows)	Peak Flow Rate MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
O25	Ohio River	Jacks Run	0	MO-4	Tunnel MO-4	66.6	N/A	6.1	21	$447.7
O26	Ohio River	Jacks Run	075AO26							
O27	Ohio River	Woods Run	044BO27							
O29	Ohio River	Doerr, Superior, and Island	044RO29							
O30	Ohio River	Doerr, Superior, and Island	021DO30							
O31	Ohio River	Adams Street	021HO31							
O32	Ohio River	Adams Street	021HO32							
O33	Ohio River	Adams Street	021MO33							
O34	Ohio River	Adams Street	021MO34							
O35	Ohio River	Pennsylvania Avenue	021SO35							
O36	Ohio River	Pennsylvania Avenue	021SO36							
O37	Ohio River	Pennsylvania Avenue	007AO37							
O38	Ohio River	Pennsylvania Avenue	007AO38							
O39	Ohio River	Pennsylvania Avenue	007EO39							
O40	Ohio River	Pennsylvania Avenue	007KO40							
O41	Ohio River	Pennsylvania Avenue	007KO41							
O43	Ohio River	Dasher Street	007MO43							
M01	Monongahela River	Commonwealth Place	001FM01							
M02	Monongahela River	Stanwix Street	001LM02							
M03	Monongahela River	Wood Street	001MM03							
M03A	Monongahela River	Cherry Way	001MM03A							
M04	Monongahela River	Grant Street	001SM04							
M05	Monongahela River	Try Street	002NM05							
M06	Monongahela River	Arlington through 25th Street	003AM06							
M07	Monongahela River	Arlington through 25th Street	003BM07							
M08	Monongahela River	Arlington through 25th Street	003BM08							
M10	Monongahela River	Arlington through 25th Street	003CM10							
M11	Monongahela River	Arlington through 25th Street	003CM11							
M12	Monongahela River	Arlington through 25th Street	003DM12							
M13	Monongahela River	Arlington through 25th Street	003DM13							
M14	Monongahela River	Arlington through 25th Street	012AM14							
M14A	Monongahela River	Arlington through 25th Street	012AM14A							
M15	Monongahela River	Arlington through 25th Street	012AM15							
M16	Monongahela River	Arlington through 25th Street	012BM16							
M17	Monongahela River	Arlington through 25th Street	012BM17							
M11A	Monongahela River	Arlington through 25th Street	003GM11A							
M19	Monongahela River	Brady Street	011RM19							
M19A	Monongahela River	M-19A Maurice Street	011SM19B							
M19BCD	Monongahela River	M-19B; M-19C & M-19D Bates Street	029FM19A							
M18	Monongahela River	Arlington through 25th Street	012CM18							
M20	Monongahela River	Arlington through 25th Street	012CM20							
M21	Monongahela River	Arlington through 25th Street	012DM21							
M22	Monongahela River	Arlington through 25th Street	012DM22							
M23	Monongahela River	Arlington through 25th Street	012HM23							
M24	Monongahela River	Arlington through 25th Street								
M26	Monongahela River	Arlington through 25th Street	029KM26							
M27	Monongahela River	Arlington through 25th Street	029PM27							
M28	Monongahela River	Arlington through 25th Street								
M29	Monongahela River	Greenfield Avenue	029RM29							
M31	Monongahela River	Rutherglen St.	030MM31							
M31A	Monongahela River	Rutherglen St.	030MM31A							
M32	Monongahela River	Tullymet Street	031DM32							
M33	Monongahela River	Longworth Street	031HM33							
M35	Monongahela River	Hazelwood Avenue Sewershed	031HM35							
M36	Monongahela River	Tecumseh Street	031MM36							
M37	Monongahela River	Melanchton Street	057AM37							
M38	Monongahela River	Vespucius Street	057KM38							
M39	Monongahela River	Renova Street	057KM39							
M40	Monongahela River	Alluvian Street	057MM40							
CSO 032P001	Monongahela River	Becks Run	032P001							
M34	Monongahela River	Becks Run	031GM34							
CSO 184E001	Monongahela River	Streets Run	184E001							
CSO 185H001	Monongahela River	Streets Run	185H001							
CSO 134A001	Monongahela River	Streets Run	134A001							
M42	Monongahela River	Streets Run	0							
M47	Monongahela River	Nine Mile Run	129NM47		Nine Mile Run Region: Screening & Disinfection	9.5	19.0	N/A	N/A	$10.6
SPS089C001	Monongahela River	Homestead Bridge	089D001							
DC129B001	Nine Mile Run	Swisshelm Park	129B001		Nine Mile Run - Frick Park Region: Sub Surface Storage	0.4	5.4	N/A	N/A	$9.5
128R002	Nine Mile Run	Nine Mile Run - Frick Park	128R002							
177K001	Nine Mile Run	Upper Nine Mile Run	177K001		Upper Nine Mile Run Region: Sub Surface Storage Tank	0.7	27.4	N/A	N/A	$8.0
CSO 030N001	Monongahela River	Becks Run	030N001		Sewer Separation	0.0	1.0	N/A	N/A	$1.7
CSO 032N001	Monongahela River	Becks Run	032N001		Sub-Surface Storage Tank	0.0	1.2	N/A	N/A	$2.3
								TOTAL COST (Million $)		$481.9

Table F-3
Monongahela - Ohio Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North / South / East Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Vol - MG (4 Overflows)	Peak Flow Rate MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
O25	Ohio River	Jacks Run	0	MO-5	Tunnel MO-5	76.5	N/A	7.5	20.3	$484.3
O26	Ohio River	Jacks Run	075AO26							
O27	Ohio River	Woods Run	044BO27							
O29	Ohio River	Doerr, Superior, and Island	044RO29							
O30	Ohio River	Doerr, Superior, and Island	021DO30							
O31	Ohio River	Adams Street	021HO31							
O32	Ohio River	Adams Street	021HO32							
O33	Ohio River	Adams Street	021MO33							
O34	Ohio River	Adams Street	021MO34							
O35	Ohio River	Pennsylvania Avenue	021SO35							
O36	Ohio River	Pennsylvania Avenue	021SO36							
O37	Ohio River	Pennsylvania Avenue	007AO37							
O38	Ohio River	Pennsylvania Avenue	007AO38							
O39	Ohio River	Pennsylvania Avenue	007EO39							
O40	Ohio River	Pennsylvania Avenue	007KO40							
O41	Ohio River	Pennsylvania Avenue	007KO41							
O43	Ohio River	Dasher Street	007MO43							
M01	Monongahela River	Commonwealth Place	001FM01							
M02	Monongahela River	Stanwix Street	001LM02							
M03	Monongahela River	Wood Street	001MM03							
M03A	Monongahela River	Cherry Way	001MM03A							
M04	Monongahela River	Grant Street	001SM04							
M05	Monongahela River	Try Street	002NM05							
M06	Monongahela River	Arlington through 25th Street	003AM06							
M07	Monongahela River	Arlington through 25th Street	003BM07							
M08	Monongahela River	Arlington through 25th Street	003BM08							
M10	Monongahela River	Arlington through 25th Street	003CM10							
M11	Monongahela River	Arlington through 25th Street	003CM11							
M12	Monongahela River	Arlington through 25th Street	003DM12							
M13	Monongahela River	Arlington through 25th Street	003DM13							
M14	Monongahela River	Arlington through 25th Street	012AM14							
M14A	Monongahela River	Arlington through 25th Street	012AM14A							
M15	Monongahela River	Arlington through 25th Street	012AM15							
M16	Monongahela River	Arlington through 25th Street	012BM16							
M17	Monongahela River	Arlington through 25th Street	012BM17							
M11A	Monongahela River	Arlington through 25th Street	003GM11A							
M19	Monongahela River	Brady Street	011RM19							
M19A	Monongahela River	M-19A Maurice Street	011SM19B							
M19BCD	Monongahela River	M-19B; M-19C & M-19D Bates Street	029FM19A							
M18	Monongahela River	Arlington through 25th Street	012CM18							
M20	Monongahela River	Arlington through 25th Street	012CM20							
M21	Monongahela River	Arlington through 25th Street	012DM21							
M22	Monongahela River	Arlington through 25th Street	012DM22							
M23	Monongahela River	Arlington through 25th Street	012HM23							
M24	Monongahela River	Arlington through 25th Street								
M26	Monongahela River	Arlington through 25th Street	029KM26							
M27	Monongahela River	Arlington through 25th Street	029PM27							
M28	Monongahela River	Arlington through 25th Street								
M29	Monongahela River	Greenfield Avenue	029RM29							
M31	Monongahela River	Rutherglen St.	030MM31							
M31A	Monongahela River	Rutherglen St.	030MM31A							
M32	Monongahela River	Tullymet Street	031DM32							
M33	Monongahela River	Longworth Street	031HM33							
M35	Monongahela River	Hazelwood Avenue Sewershed	031HM35							
M36	Monongahela River	Tecumseh Street	031MM36							
M37	Monongahela River	Melanchton Street	057AM37							
M38	Monongahela River	Vespucius Street	057KM38							
M39	Monongahela River	Renova Street	057KM39							
M40	Monongahela River	Alluvian Street	057MM40							
CSO 032P001	Monongahela River	Becks Run	032P001							
M34	Monongahela River	Becks Run	031GM34							
CSO 184E001	Monongahela River	Streets Run	184E001							
CSO 185H001	Monongahela River	Streets Run	185H001							
CSO 134A001	Monongahela River	Streets Run	134A001							
M42	Monongahela River	Streets Run	0							
M47	Monongahela River	Nine Mile Run	129NM47							
SPS089C001	Monongahela River	Homestead Bridge	089D001							
DC129B001	Nine Mile Run	Swisshelm Park	129B001		Nine Mile Run - Frick Park Region: Sub Surface Storage	0.4	5.4	N/A	N/A	$9.5
128R002	Nine Mile Run	Nine Mile Run - Frick Park	128R002							
177K001	Nine Mile Run	Upper Nine Mile Run	177K001		Upper Nine Mile Run Region: Sub Surface Storage Tank	0.7	27.4	N/A	N/A	$8.0
CSO 030N001	Monongahela River	Becks Run	030N001		Sewer Separation	0.01	1.04	N/A	N/A	$1.7
CSO 032N001	Monongahela River	Becks Run	032N001		Sub-Surface Storage Tank	0.02	1.21	N/A	N/A	$2.3
								TOTAL COST (Million $)		$488.3

Table F-3
Monongahela - Ohio Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North / South / East Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall (4 Overflows)	Peak Vol - MG (4 Overflows)	Peak Flow Rate MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
O25	Ohio River	Jacks Run	0	MO-6	Tunnel MO-6	58.5	N/A	5.0	22	$375.3
O26	Ohio River	Jacks Run	075AO26							
O27	Ohio River	Woods Run	044BO27							
O29	Ohio River	Doerr, Superior, and Island	044RO29							
O30	Ohio River	Doerr, Superior, and Island	021DO30							
O31	Ohio River	Adams Street	021HO31							
O32	Ohio River	Adams Street	021HO32							
O33	Ohio River	Adams Street	021MO33							
O34	Ohio River	Adams Street	021MO34							
O35	Ohio River	Pennsylvania Avenue	021SO35							
O36	Ohio River	Pennsylvania Avenue	021SO36							
O37	Ohio River	Pennsylvania Avenue	007AO37							
O38	Ohio River	Pennsylvania Avenue	007AO38							
O39	Ohio River	Pennsylvania Avenue	007EO39							
O40	Ohio River	Pennsylvania Avenue	007KO40							
O41	Ohio River	Pennsylvania Avenue	007KO41							
O43	Ohio River	Dasher Street	007MO43							
M01	Monongahela River	Commonwealth Place	001FM01							
M02	Monongahela River	Stanwix Street	001LM02							
M03	Monongahela River	Wood Street	001MM03							
M03A	Monongahela River	Cherry Way	001MM03A							
M04	Monongahela River	Grant Street	001SM04							
M05	Monongahela River	Try Street	002NM05							
M06	Monongahela River	Arlington through 25th Street	003AM06							
M07	Monongahela River	Arlington through 25th Street	003BM07							
M08	Monongahela River	Arlington through 25th Street	003BM08							
M10	Monongahela River	Arlington through 25th Street	003CM10							
M11	Monongahela River	Arlington through 25th Street	003CM11							
M12	Monongahela River	Arlington through 25th Street	003DM12							
M13	Monongahela River	Arlington through 25th Street	003DM13							
M14	Monongahela River	Arlington through 25th Street	012AM14							
M14A	Monongahela River	Arlington through 25th Street	012AM14A							
M15	Monongahela River	Arlington through 25th Street	012AM15							
M16	Monongahela River	Arlington through 25th Street	012BM16							
M17	Monongahela River	Arlington through 25th Street	012BM17							
M11A	Monongahela River	Arlington through 25th Street	003GM11A							
M19	Monongahela River	Brady Street	011RM19							
M19A	Monongahela River	M-19A Maurice Street	011SM19B							
M19BCD	Monongahela River	M-19B; M-19C & M-19D Bates Street	029FM19A							
M18	Monongahela River	Arlington through 25th Street	012CM18							
M20	Monongahela River	Arlington through 25th Street	012CM20							
M21	Monongahela River	Arlington through 25th Street	012DM21							
M22	Monongahela River	Arlington through 25th Street	012DM22							
M23	Monongahela River	Arlington through 25th Street	012HM23							
M24	Monongahela River	Arlington through 25th Street								
M26	Monongahela River	Arlington through 25th Street	029KM26							
M27	Monongahela River	Arlington through 25th Street	029PM27							
M28	Monongahela River	Arlington through 25th Street								
M29	Monongahela River	Greenfield Avenue	029RM29							
M31	Monongahela River	Rutherglen St.	030MM31		Hazelwood Region: Tunnel Storage	0.1	6.9	N/A	N/A	$51.1
M31A	Monongahela River	Rutherglen St.	030MM31A			#N/A	#N/A			
M32	Monongahela River	Tullymet Street	031DM32			0.1	3.2			
M33	Monongahela River	Longworth Street	031HM33			0.1	2.5			
M35	Monongahela River	Hazelwood Avenue Sewershed	031HM35			1.6	21.9			
M36	Monongahela River	Tecumseh Street	031MM36			1.9	34.9			
M37	Monongahela River	Melanchton Street	057AM37			0.1	4.8			
M38	Monongahela River	Vespucius Street	057KM38			0.0	0.8			
M39	Monongahela River	Renova Street	057KM39			0.1	2.4			
M40	Monongahela River	Alluvian Street	057MM40			0.5	20.2			
CSO 032P001	Monongahela River	Becks Run	032P001		No Activation	0.0	0.0	N/A	N/A	$0.0
M34	Monongahela River	Becks Run	031GM34		Surface Storage Tank	6.1	21.9	N/A	N/A	$16.0
CSO 184E001	Monongahela River	Streets Run	184E001		Screen and Disinfection	7.8	20.0	N/A	N/A	$22.9
CSO 185H001	Monongahela River	Streets Run	185H001							
CSO 134A001	Monongahela River	Streets Run	134A001							
M42	Monongahela River	Streets Run	0							
M47	Monongahela River	Nine Mile Run	129NM47		Tunnel MO-6					
SPS089C001	Monongahela River	Homestead Bridge	089D001							
DC129B001	Nine Mile Run	Swisshelm Park	129B001		Nine Mile Run - Frick Park Region: Sub Surface Storage	0.4	5.4	N/A	N/A	$9.5
128R002	Nine Mile Run	Nine Mile Run - Frick Park	128R002							
177K001	Nine Mile Run	Upper Nine Mile Run	177K001		Upper Nine Mile Run Region: Sub Surface Storage Tank	0.7	27.4	N/A	N/A	$8.0
CSO 030N001	Monongahela River	Becks Run	030N001		Sewer Separation	0.01	1.04	N/A	N/A	$1.7
CSO 032N001	Monongahela River	Becks Run	032N001		Sub-Surface Storage Tank	0.02	1.21	N/A	N/A	$2.3
								TOTAL COST (Million $)		$469.4

Table F-4
Sawmill Run Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 095PS18	Ohio River	Sawmill Run Interceptor (O-14)	007PO14B	SMR-1a	Sub-Surface Storage	0.15	10.34	--	--	$19.2
CSO 095E001	Sawmill Run	Brook-line Blvd.	095E001							
CSO 095J001	Sawmill Run	Englert and Weyman Streets	095J001							
ACSO 061DS23	Sawmill Run	Bausman, Brook and Warrington			Sub-Surface Storage	1.38	47.37	--	--	$27.7
ACSO 061DS24	Sawmill Run	Edge-brook Ave.	061DS24							
ACSO 034LS28	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 034GS29	Sawmill Run	Bausman, Brook and Warrington								
CSO 060A001	Sawmill Run	Bausman, Brook and Warrington	060A001							
CSO 005R001	Sawmill Run	Olympia, Shaler and Woodruff Streets			Tunnel[1]	25	--	2.8	19	$154.4
ACSO 005LS39	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005F001	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005AS41	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 019MS42	Sawmill Run	McCartney Run								
ACSO 006AS46	Ohio River	Sawmill Run Interceptor (O-14)								
'O-14-E-OF'	Ohio River	Sawmill Run Interceptor (O-14)	007PO14							
'O-14-W-OF'	Ohio River	Sawmill Run Interceptor (O-14)	007PO14A							
ACSO 007N014B	Ohio River	Sawmill Run Interceptor (O-14)	007NO14B							
CSO 016A002	Sawmill Run	Little Sawmill Run	016A002		Sub-Surface Storage	0.42	16.76	--	--	$19.4
CSO 016A001	Sawmill Run	Little Sawmill Run	016A001							
CSO 035A001	Sawmill Run	Little Sawmill Run	035A001							
CSO 035E001	Sawmill Run	Little Sawmill Run	035E001							
CSO 035J001	Sawmill Run	Little Sawmill Run	035J001							
CSO 036R001	Sawmill Run	Little Sawmill Run	036RO01		Sub-Surface Storage	0.76	32.44	--	--	$10.2
CSO 019M001	Sawmill Run	McCartney Run			Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above
CSO 097L001	Sawmill Run	McDonoughs Run	097L001		Sub-Surface Storage	0.22	12.02	--	--	$4.2
CSO 139A001	Sawmill Run	McDonoughs Run	139A001		Sub-Surface Storage	1.18	53.2	--	--	$21.3
CSO 139B001	Sawmill Run	McDonoughs Run	139B001							
CSO 139B002	Sawmill Run	McDonoughs Run	139B002							
CSO 139B003	Sawmill Run	McDonoughs Run	139B003		Low Flow/Remote (Sewer Separation)	0.01	0.63	--	--	$3.4
	Sawmill Run	McDonoughs Run			No Activations	-	-	--	--	-
ACSO 034BS30	Ohio River	Sawmill Run Interceptor (O-14)			Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above
ACSO 015PS31	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 015PS32	Sawmill Run	Bausman, Brook and Warrington								
ACSO 015JS33	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015JS34	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015ES35	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015AS36	Ohio River	Sawmill Run Interceptor (O-14)								
CSO 015P001	Sawmill Run	Plummers Run	015P001							
DC 034N001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.004	0.36	--	--	$1.3
DC 035P001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.001	0.09	--	--	$0.7
DC 035S001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.003	0.23	--	--	$0.5
DC 035S002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Direct Connection to Trunk Sewer	NA	NA	--	--	NA
DC 062C001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	N/A	N/A	--	--	$0.9
DC 062C002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		No Activations	-	-	--	--	-
DC 062D001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.01	0.51	--	--	$2.4
DC 062K001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		No Activations	-	-	--	--	-
DC 062K002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.001	0.18	--	--	$0.7
CSO 034R001	Ohio River	Sawmill Run Interceptor (O-14)	034R001		Low Flow/Remote (Sewer Separation)	0.01	0.68	--	--	$2.6
CSO 138J001	Sawmill Run	Englert and Weyman Streets			Sewer Separation	0.01	0.64	--	--	$3.2
CSO 138P001	Sawmill Run	Englert and Weyman Streets								
CSO 138K001	Sawmill Run	Englert and Weyman Streets	138K001		No Activations	-	-	--	--	-
								TOTAL COST (Million $)		$272.1

Notes: (1) This tunnel is continuous

Table F-4
Sawmill Run Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 095PS18	Ohio River	Sawmill Run Interceptor (O-14)	007PO14B	SMR-1b	Sub-Surface Storage	0.15	10.34	--	--	$19.2
CSO 095E001	Sawmill Run	Brook-line Blvd.	095E001							
CSO 095J001	Sawmill Run	Englert and Weyman Streets	095J001							
ACSO 061DS23	Sawmill Run	Bausman, Brook and Warrington			Sub-Surface Storage	1.38	47.37	--	--	$27.7
ACSO 061DS24	Sawmill Run	Edge-brook Ave.	061DS24							
ACSO 034LS28	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 034GS29	Sawmill Run	Bausman, Brook and Warrington								
CSO 060A001	Sawmill Run	Bausman, Brook and Warrington	060A001							
CSO 005R001	Sawmill Run	Olympia, Shaler and Woodruff Streets			Tunnel(1)	22.27	--	5.7	18	$185.9
ACSO 005LS39	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005F001	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005AS41	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 019MS42	Sawmill Run	McCartney Run								
ACSO 006AS46	Ohio River	Sawmill Run Interceptor (O-14)								
'O-14-E-OF'	Ohio River	Sawmill Run Interceptor (O-14)	007PO14							
'O-14-W-OF'	Ohio River	Sawmill Run Interceptor (O-14)	007PO14A							
ACSO 007N014B	Ohio River	Sawmill Run Interceptor (O-14)	007NO14B							
CSO 016A002	Sawmill Run	Little Sawmill Run	016A002							
CSO 016A001	Sawmill Run	Little Sawmill Run	016A001							
CSO 035A001	Sawmill Run	Little Sawmill Run	035A001							
CSO 035E001	Sawmill Run	Little Sawmill Run	035E001							
CSO 035J001	Sawmill Run	Little Sawmill Run	035J001							
CSO 036R001	Sawmill Run	Little Sawmill Run	036RO01							
CSO 019M001	Sawmill Run	McCartney Run								
CSO 097L001	Sawmill Run	McDonoughs Run	097L001		Sub-Surface Storage	0.22	12.02	--	--	$4.2
CSO 139A001	Sawmill Run	McDonoughs Run	139A001		Sub-Surface Storage	1.18	53.2	--	--	$21.3
CSO 139B001	Sawmill Run	McDonoughs Run	139B001							
CSO 139B002	Sawmill Run	McDonoughs Run	139B002							
CSO 139B003	Sawmill Run	McDonoughs Run	139B003		Low Flow/Remote (Sewer Separation)	0.01	0.63	--	--	$3.4
	Sawmill Run	McDonoughs Run			No Activations	-	-	--	--	-
ACSO 034BS30	Ohio River	Sawmill Run Interceptor (O-14)			Tunnel(1) see above	Tunnel(1) see above	Tunnel(1) see above	Tunnel(1) see above	Tunnel(1) see above	Tunnel(1) see above
ACSO 015PS31	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 015PS32	Sawmill Run	Bausman, Brook and Warrington								
ACSO 015JS33	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015JS34	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015ES35	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015AS36	Ohio River	Sawmill Run Interceptor (O-14)								
CSO 015P001	Sawmill Run	Plummers Run	015P001							
DC 034N001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.004	0.36	--	--	$1.3
DC 035P001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.001	0.09	--	--	$0.7
DC 035S001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.003	0.23	--	--	$0.5
DC 035S002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Direct Connection to Trunk Sewer	NA	NA	--	--	NA
DC 062C001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	N/A	N/A	--	--	$0.9
DC 062C002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		No Activations	-	-	--	--	-
DC 062D001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.01	0.51	--	--	$2.4
DC 062K001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		No Activations	-	-	--	--	-
DC 062K002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.001	0.18	--	--	$0.7
CSO 034R001	Ohio River	Sawmill Run Interceptor (O-14)	034R001		Low Flow/Remote (Sewer Separation)	0.01	0.68	--	--	$2.6
CSO 138J001	Sawmill Run	Englert and Weyman Streets			Sewer Separation	0.01	0.64	-	-	$3.2
CSO 138P001	Sawmill Run	Englert and Weyman Streets								
CSO 138K001	Sawmill Run	Englert and Weyman Streets	138K001		No Activations	-	-	-	-	-
								TOTAL COST (Million $)		$274.00

Notes: (1) This tunnel is continuous

Table F-4
Sawmill Run Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 095PS18	Ohio River	Sawmill Run Interceptor (O-14)	007PO14B	SMR-2a	Tunnel[1]	25.81	--	5.7	13.5	$223.2
CSO 095E001	Sawmill Run	Brook-line Blvd.	095E001							
CSO 095J001	Sawmill Run	Englert and Weyman Streets	095J001							
ACSO 061DS23	Sawmill Run	Bausman, Brook and Warrington								
ACSO 061DS24	Sawmill Run	Edge-brook Ave.	061DS24							
ACSO 034LS28	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 034GS29	Sawmill Run	Bausman, Brook and Warrington								
CSO 060A001	Sawmill Run	Bausman, Brook and Warrington	060A001							
CSO 005R001	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005LS39	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005F001	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005AS41	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 019MS42	Sawmill Run	McCartney Run								
ACSO 006AS46	Ohio River	Sawmill Run Interceptor (O-14)								
'O-14-E-OF'	Ohio River	Sawmill Run Interceptor (O-14)	007PO14							
'O-14-W-OF'	Ohio River	Sawmill Run Interceptor (O-14)	007PO14A							
ACSO 007N014B	Ohio River	Sawmill Run Interceptor (O-14)	007NO14B							
CSO 016A002	Sawmill Run	Little Sawmill Run	016A002		Sub-Surface Storage	0.42	16.76	--	--	$19.4
CSO 016A001	Sawmill Run	Little Sawmill Run	016A001							
CSO 035A001	Sawmill Run	Little Sawmill Run	035A001							
CSO 035E001	Sawmill Run	Little Sawmill Run	035E001							
CSO 035J001	Sawmill Run	Little Sawmill Run	035J001							
CSO 036R001	Sawmill Run	Little Sawmill Run	036RO01		Sub-Surface Storage	0.76	32.44	--	--	$10.2
CSO 019M001	Sawmill Run	McCartney Run			Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above	Tunnel[1] see above
CSO 097L001	Sawmill Run	McDonoughs Run	097L001							
CSO 139A001	Sawmill Run	McDonoughs Run	139A001							
CSO 139B001	Sawmill Run	McDonoughs Run	139B001							
CSO 139B002	Sawmill Run	McDonoughs Run	139B002							
CSO 139B003	Sawmill Run	McDonoughs Run	139B003							
	Sawmill Run	McDonoughs Run								
ACSO 034BS30	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015PS31	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 015PS32	Sawmill Run	Bausman, Brook and Warrington								
ACSO 015JS33	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015JS34	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015ES35	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015AS36	Ohio River	Sawmill Run Interceptor (O-14)								
CSO 015P001	Sawmill Run	Plummers Run	015P001							
DC 034N001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.004	0.36	--	--	$1.3
DC 035P001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.001	0.09	--	--	$0.7
DC 035S001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.003	0.23	--	--	$0.5
DC 035S002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Direct Connection to Trunk Sewer	NA	NA	--	--	NA
DC 062C001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	N/A	N/A	--	--	$0.9
DC 062C002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		No Activations	-	-	--	--	-
DC 062D001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.01	0.51	--	--	$2.4
DC 062K001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		No Activations	-	-	--	--	-
DC 062K002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.001	0.18	--	--	$0.7
CSO 034R001	Ohio River	Sawmill Run Interceptor (O-14)	034R001		Low Flow/Remote (Sewer Separation)	0.01	0.68	--	--	$2.6
CSO 138J001	Sawmill Run	Englert and Weyman Streets			Sewer Separation	0.01	0.64	-	-	$3.2
CSO 138P001	Sawmill Run	Englert and Weyman Streets								
CSO 138K001	Sawmill Run	Englert and Weyman Streets	138K001		No Activations	-	-	-	-	-
								TOTAL COST (Million $)		$265.1

Notes: (1) This tunnel is continuous

Table F-4
Sawmill Run Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 095PS18	Ohio River	Sawmill Run Interceptor (O-14)	007PO14B							
CSO 095E001	Sawmill Run	Brook-line Blvd.	095E001							
CSO 095J001	Sawmill Run	Englert and Weyman Streets	095J001							
ACSO 061DS23	Sawmill Run	Bausman, Brook and Warrington								
ACSO 061DS24	Sawmill Run	Edge-brook Ave.	061DS24							
ACSO 034LS28	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 034GS29	Sawmill Run	Bausman, Brook and Warrington								
CSO 060A001	Sawmill Run	Bausman, Brook and Warrington	060A001							
CSO 005R001	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005LS39	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005F001	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 005AS41	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 019MS42	Sawmill Run	McCartney Run								
ACSO 006AS46	Ohio River	Sawmill Run Interceptor (O-14)								
'O-14-E-OF'	Ohio River	Sawmill Run Interceptor (O-14)	007PO14							
'O-14-W-OF'	Ohio River	Sawmill Run Interceptor (O-14)	007PO14A							
ACSO 007N014B	Ohio River	Sawmill Run Interceptor (O-14)	007NO14B							
CSO 016A002	Sawmill Run	Little Sawmill Run	016A002							
CSO 016A001	Sawmill Run	Little Sawmill Run	016A001							
CSO 035A001	Sawmill Run	Little Sawmill Run	035A001		Tunnel	24.31	--	5.8	13	$256.7
CSO 035E001	Sawmill Run	Little Sawmill Run	035E001							
CSO 035J001	Sawmill Run	Little Sawmill Run	035J001							
CSO 036R001	Sawmill Run	Little Sawmill Run	036RO01							
CSO 019M001	Sawmill Run	McCartney Run								
CSO 097L001	Sawmill Run	McDonoughs Run	097L001							
CSO 139A001	Sawmill Run	McDonoughs Run	139A001	SMR-2b						
CSO 139B001	Sawmill Run	McDonoughs Run	139B001							
CSO 139B002	Sawmill Run	McDonoughs Run	139B002							
CSO 139B003	Sawmill Run	McDonoughs Run	139B003							
	Sawmill Run	McDonoughs Run								
ACSO 034BS30	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015PS31	Sawmill Run	Olympia, Shaler and Woodruff Streets								
ACSO 015PS32	Sawmill Run	Bausman, Brook and Warrington								
ACSO 015JS33	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015JS34	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015ES35	Ohio River	Sawmill Run Interceptor (O-14)								
ACSO 015AS36	Ohio River	Sawmill Run Interceptor (O-14)								
CSO 015P001	Sawmill Run	Plummers Run	015P001							
DC 034N001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.004	0.36	--	--	$1.3
DC 035P001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.001	0.09	--	--	$0.7
DC 035S001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.003	0.23	--	--	$0.5
DC 035S002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Direct Connection to Trunk Sewer	NA	NA	--	--	NA
DC 062C001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	N/A	N/A	--	--	$0.9
DC 062C002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		No Activations	-	-	--	--	-
DC 062D001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.01	0.51	--	--	$2.4
DC 062K001	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		No Activations	-	-	--	--	-
DC 062K002	Sawmill Run	Plummers Run	015P001 (Flows to CSO 015P001)		Low Flow/Remote (Sewer Separation)	0.001	0.18	--	--	$0.7
CSO 034R001	Ohio River	Sawmill Run Interceptor (O-14)	034R001		Low Flow/Remote (Sewer Separation)	0.01	0.68	--	--	$2.6
CSO 138J001	Sawmill Run	Englert and Weyman Streets			Sewer Separation	0.01	0.64	-	-	$3.2
CSO 138P001	Sawmill Run	Englert and Weyman Streets								
CSO 138K001	Sawmill Run	Englert and Weyman Streets	138K001		No Activations	-	-	-	-	-
								TOTAL COST (Million $)		$269.0

Notes: (1) This tunnel is continuous

Table F-5
Chartiers-Glen Mawr Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 043SC02	Chartiers Creek	Lower Chartiers Creek	043SC02	CC-1	Tunnel	7.16	--	2.2	11.5	$73.9
ACSO 043RC03	Chartiers Creek	Lower Chartiers Creek	043RC03							
ACSO 043RC05	Chartiers Creek	Lower Chartiers Creek	043RC05							
ACSO 043RC05A	Chartiers Creek	Lower Chartiers Creek								
ACSO 043PC07	Chartiers Creek	Lower Chartiers Creek	043PC07							
ACSO 071CC11	Chartiers Creek	Lower Chartiers Creek	071CC11							
ACSO 071CC12	Chartiers Creek	Lower Chartiers Creek	071CC12							
ACSO 072PC13A	Chartiers Creek	Lower Chartiers Creek	072RC13A							
ACSO 107GC14	Chartiers Creek	Lower Chartiers Creek	107GC14							
ACSO 107SC15	Chartiers Creek	Lower Chartiers Creek	107SC15							
ACSO 104HC25	Chartiers Creek	Bells Run	104HC25		Surface Storage	4.25	26.58	--	--	$15.4
ACSO 079FC26A	Chartiers Creek	Upper Chartiers Creek	067FC26A		Screening & Disinfection	2.76	11.64	-	-	$8.5
ACSO 067FC27	Chartiers Creek	Upper Chartiers Creek	067FC27							
ACSO 067KC28	Chartiers Creek	Upper Chartiers Creek	067KC28							
ACSO 067KC29	Chartiers Creek	Upper Chartiers Creek	067KC29							
CSO 039E001	Chartiers Creek	Bells Run	039E001		Sub-Surface Storage	0.82	34.48	-	-	29.9
CSO 039J001	Chartiers Creek	Bells Run	039J001							
CSO 068H001	Chartiers Creek	Bells Run	068H001							
CSO 068H002	Chartiers Creek	Bells Run	068H002							
CSO 039K001	Chartiers Creek	Bells Run	039K001							
ACSO 043SO08	Ohio River	Glen Mawr (Ohio River)	043SO08	GM-1	Tunnel	6.31	--	1.1	15.5	$52.1
ACSO 042DO09	Ohio River	Glen Mawr (Ohio River)	042DO09							
ACSO 021AO10	Ohio River	Glen Mawr (Ohio River)	021AO10							
ACSO 021KO11	Ohio River	Glen Mawr (Ohio River)	021KO11							
ACSO 021RO13	Ohio River	Glen Mawr (Ohio River)	021RO13							
								TOTAL COST CC-1 (Million $)		**$127.7**
								TOTAL COST CC-1 AND GM-1 (Million $)		**$179.8**

Table F-5
Chartiers-Glen Mawr Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 043SC02	Chartiers Creek	Lower Chartiers Creek	043SC02	CC-2	Tunnel	13.99	-	4.7	11	$145.1
ACSO 043RC03	Chartiers Creek	Lower Chartiers Creek	043RC03							
ACSO 043RC05	Chartiers Creek	Lower Chartiers Creek	043RC05							
ACSO 043RC05A	Chartiers Creek	Lower Chartiers Creek								
ACSO 043PC07	Chartiers Creek	Lower Chartiers Creek	043PC07							
ACSO 071CC11	Chartiers Creek	Lower Chartiers Creek	071CC11							
ACSO 071CC12	Chartiers Creek	Lower Chartiers Creek	071CC12							
ACSO 072PC13A	Chartiers Creek	Lower Chartiers Creek	072RC13A							
ACSO 107GC14	Chartiers Creek	Lower Chartiers Creek	107GC14							
ACSO 107SC15	Chartiers Creek	Lower Chartiers Creek	107SC15							
ACSO 104HC25	Chartiers Creek	Bells Run	104HC25							
ACSO 079FC26A	Chartiers Creek	Upper Chartiers Creek	067FC26A							
ACSO 067FC27	Chartiers Creek	Upper Chartiers Creek	067FC27							
ACSO 067KC28	Chartiers Creek	Upper Chartiers Creek	067KC28							
ACSO 067KC29	Chartiers Creek	Upper Chartiers Creek	067KC29							
CSO 039E001	Chartiers Creek	Bells Run	039E001							
CSO 039J001	Chartiers Creek	Bells Run	039J001							
CSO 068H001	Chartiers Creek	Bells Run	068H001							
CSO 068H002	Chartiers Creek	Bells Run	068H002							
CSO 039K001	Chartiers Creek	Bells Run	039K001							
ACSO 043SO08	Ohio River	Glen Mawr (Ohio River)	043SO08	GM-1	Tunnel	6.31	--	1.1	15.5	$52.1
ACSO 042DO09	Ohio River	Glen Mawr (Ohio River)	042DO09							
ACSO 021AO10	Ohio River	Glen Mawr (Ohio River)	021AO10							
ACSO 021KO11	Ohio River	Glen Mawr (Ohio River)	021KO11							
ACSO 021RO13	Ohio River	Glen Mawr (Ohio River)	021RO13							
								TOTAL COST CC-1 (Million $)		**$145.1**
								TOTAL COST CC-1 AND GM-1 (Million $)		**$197.2**

Table F-5
Chartiers-Glen Mawr Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 043SC02	Chartiers Creek	Lower Chartiers Creek	043SC02	CC-3	Tunnel	18.26	-	4.7	12.5	$182.8
ACSO 043RC03	Chartiers Creek	Lower Chartiers Creek	043RC03							
ACSO 043RC05	Chartiers Creek	Lower Chartiers Creek	043RC05							
ACSO 043RC05A	Chartiers Creek	Lower Chartiers Creek								
ACSO 043PC07	Chartiers Creek	Lower Chartiers Creek	043PC07							
ACSO 071CC11	Chartiers Creek	Lower Chartiers Creek	071CC11							
ACSO 071CC12	Chartiers Creek	Lower Chartiers Creek	071CC12							
ACSO 072PC13A	Chartiers Creek	Lower Chartiers Creek	072RC13A							
ACSO 107GC14	Chartiers Creek	Lower Chartiers Creek	107GC14							
ACSO 107SC15	Chartiers Creek	Lower Chartiers Creek	107SC15							
ACSO 104HC25	Chartiers Creek	Bells Run	104HC25							
ACSO 079FC26A	Chartiers Creek	Upper Chartiers Creek	067FC26A							
ACSO 067FC27	Chartiers Creek	Upper Chartiers Creek	067FC27							
ACSO 067KC28	Chartiers Creek	Upper Chartiers Creek	067KC28							
ACSO 067KC29	Chartiers Creek	Upper Chartiers Creek	067KC29							
CSO 039E001	Chartiers Creek	Bells Run	039E001							
CSO 039J001	Chartiers Creek	Bells Run	039J001							
CSO 068H001	Chartiers Creek	Bells Run	068H001							
CSO 068H002	Chartiers Creek	Bells Run	068H002							
CSO 039K001	Chartiers Creek	Bells Run	039K001							
ACSO 043SO08	Ohio River	Glen Mawr (Ohio River)	043SO08							
ACSO 042DO09	Ohio River	Glen Mawr (Ohio River)	042DO09							
ACSO 021AO10	Ohio River	Glen Mawr (Ohio River)	021AO10							
ACSO 021KO11	Ohio River	Glen Mawr (Ohio River)	021KO11							
ACSO 021RO13	Ohio River	Glen Mawr (Ohio River)	021RO13							
								TOTAL COST CC-1 (Million $)		**$182.8**

Table F-6
Glen Mawr Subsystem Alternative Summary

Structure Name	Stream of Discharge	PWSA North/South Sewersheds	NPDES Permit Number	Alternative Name	CSO Control for Outfall	Peak Volume - MG (4 Overflows)	Peak Flow Rate - MGD (4 Overflows)	Tunnel Length (miles)	Tunnel Diameter - ft (4 Overflows)	Present Worth Cost - Million $ (4 Overflows)
ACSO 043SO08	Ohio River	Glen Mawr (Ohio River)	043SO08	GM-1	Tunnel	6.31	--	1.1	15.5	$52.1
ACSO 042DO09	Ohio River	Glen Mawr (Ohio River)	042DO09							
ACSO 021AO10	Ohio River	Glen Mawr (Ohio River)	021AO10							
ACSO 021KO11	Ohio River	Glen Mawr (Ohio River)	021KO11							
ACSO 021RO13	Ohio River	Glen Mawr (Ohio River)	021RO13							
									TOTAL COST (Million $)	$52.1

Alternative Menu

AN-1				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 13,050,000
TUNNEL STORAGE (A-47 through A-58)				
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
A-60 through A-66				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	141.91 MGD	Screening & Disinfection	$ 61.4	$ 51,704,000
CSO 163G001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Sewer Separation (Remote/Low	$ 3.2	$ 3,207,000

Alternative Menu

AN-2				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 30,225,000
TUNNEL STORAGE (A-47 through A-66)				
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
CSO 163G001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Sewer Separation (Remote/Low Fl	$ 3.2	$ 3,207,000

Objective Scoring

Alternative:	AN-1	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	5
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	AN-1	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP	3
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	AN-1	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	3
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	AN-1	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	3
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	AN-1	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	3
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	AN-1	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	AN-1	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	3
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	AN-1	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	AN-1	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	3
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	AN-1	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	AN-1	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	3
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	AN-1	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	2
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	AN-1	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	AN-2	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	3
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	AN-2	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP	4
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	AN-2	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	4
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	AN-2	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	4
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	AN-2	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	4
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	AN-2	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	3
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	AN-2	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	3
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	AN-2	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	AN-2	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	4
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	AN-2	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	AN-2	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	5
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	AN-2	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	3
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	AN-2	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Total Score

Alternative:	AN-1		Control Level:	0 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.112	0.056
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	5	1.00	0.128	0.128
			Sum Total:	**0.618**

Alternative:	AN-1		Control Level:	1 Overflow / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	4	0.75	0.128	0.096
			Sum Total:	**0.600**

Alternative:	AN-1		Control Level:	2 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	1	0.00	0.147	0.000
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	1	0.00	0.128	0.000
			Sum Total:	**0.357**

Alternative:	AN-1		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score

Total Score

Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.605**

Alternative:	**AN-1**		**Control Level:**	**6 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.605**

Total Score

Alternative:	**AN-2**		**Control Level:**	**0 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	1	0.00	0.147	0.000
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	4	0.85	0.062	0.053
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	1	0.00	0.040	0.000
Operating Complexity	4	0.82	0.078	0.064
Flexibility	1	0.00	0.053	0.000
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	1	0.00	0.128	0.000
			Sum Total:	**0.468**

Alternative:	**AN-2**		**Control Level:**	**1 Overflow / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	2	0.25	0.147	0.037
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	4	0.85	0.062	0.053
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	2	0.25	0.128	0.032
			Sum Total:	**0.629**

Alternative:	**AN-2**		**Control Level:**	**2 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	1	0.00	0.147	0.000
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	4	0.85	0.062	0.053
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	1	0.00	0.128	0.000
			Sum Total:	**0.560**

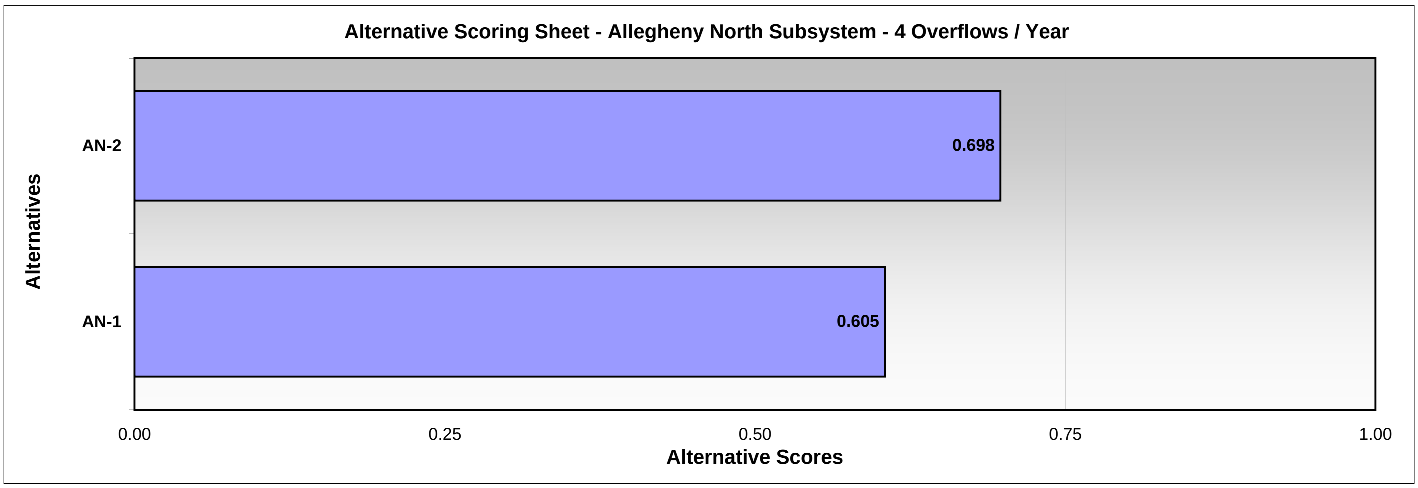
Alternative:	**AN-2**		**Control Level:**	**4 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score

Total Score

Present Worth Cost	3	0.50	0.147	0.074
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	4	0.85	0.062	0.053
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.698**

Alternative:	**AN-2**		**Control Level:**	**6 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	3	0.50	0.147	0.074
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	4	0.85	0.062	0.053
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.698**

Alternative Scoring Sheet



RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	78	
Peak Volume	1,637,876	CF
	12.25	MG
Total Volume	30,023,039	CF
	224.57	MG
Peak Rate	308.78	CFS
	199.55	MGD

CONSOLIDATION SEWERS - Total	
78 Overflows / Year	
SUBTOTAL CAPITAL COST $	**13,050,000**

TUNNEL STORAGE (A-47 through A-58)			
78 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	12.25	1,638,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	15.31	2,048,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	18.5		Input by Engineer
Tunnel Volume / Ft length (CF)	268.67		Ref: Tunnel diameter
Tunnel Length (Ft)	7,623		= Req'd Fac Vol / Vol per Ft Length; Target length is 7,255 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	4	3	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MDG)	0	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**34,982,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	12.25	18.96	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	24		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	6.0	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	100		Input by Engineer
Construction Cost (PS / Force Main) $	**2,989,000**	**$ 32,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	102.93		Peak Flow / # drop shaft
Diameter (In)	78		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	-		75' per drop shaft
Average Depth (Ft)	-		Input by Engineer
Construction Cost (Consolidation Pipe) $	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	3,072,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	153,600		= ACH x Volume / 60
Construction Cost (Odor Control) $	**4,732,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	12.25		Ref: CSO Statistics
Construction Cost (Screening) $	**980,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	12.25		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	6.13		= Peak Vol/DW Time
Construction Cost $	**10,976,522**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	3		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**3,855,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	7,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	3,063		250 SF / MGD
Land Required - Odor Control (SF)	7,680		500 SF / 10,000 CFM
Land Required - Screening (SF)	3,063		250 SF / MGD
Land Required - Regulator (SF)	30,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*51,000*		
Land Required Cost (/ SF)	$ 2		Ref: Technical Parameters
Land Acquisition Cost $	**102,000**		
		SUBTOTAL CAPITAL COST $	**58,648,522**

RIVER CROSSING #1 - Microtunnel - N/A			
78 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
78 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

Capital Costs

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
78 Overflows / Year			
1.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
2.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
3.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
4. A-60 through A-66			
Screening & Disinfection	141.91 MGD	51,704,000	Size & Cost by Engineer (from Regional Alts)
5. CSO 163G001			
Sewer Separation (Remote/Low Flow)	-	3,207,000	Size & Cost by Engineer (from Regional Alts)
6.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
7.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
8.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
9.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
10.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
		SUBTOTAL CAPITAL COST	**$ 54,911,000**

TOTAL CAPITAL COST $ 126,609,522

Capital Costs

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	92	
Peak Volume	4,028,963	CF
	30.14	MG
Total Volume	89,412,989	CF
	668.81	MG
Peak Rate	479.22	CFS
	309.71	MGD

CONSOLIDATION SEWERS - Total	
92 Overflows / Year	
SUBTOTAL CAPITAL COST $	**30,225,000**

TUNNEL STORAGE (A-47 through A-66)				
92 Overflows / Year				
1. Tunnel Parameters				
Tunnel Type (1=Rock; 2=Soft Ground)		1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		30.14	4,029,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)		37.67	5,036,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		20.5		Input by Engineer
Tunnel Volume / Ft length (CF)		329.90		Ref: Tunnel diameter
Tunnel Length (Ft)		15,265		= Req'd Fac Vol / Vol per Ft Length; Target length is 14,923 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		8	5	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MDG)		0	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**82,803,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters				
Volume Requiring Pumping (%)		100%		Ref: Technical Parameters
Dewatering Time (Days)		1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		30.14	46.63	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		38		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		5.9	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		100		Input by Engineer
Construction Cost (PS / Force Main)	**$**	**7,760,000**	**$ 46,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)				
Peak Flow (CFS) per Vortex Drop Shaft		95.84		Peak Flow / # drop shaft
Diameter (In)		66		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-		75' per drop shaft
Average Depth (Ft)		-		Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters				
Air Changes / Hour (ACH)		3		Ref: Technical Parameters
Volume of Ventilated Space (CF)		7,554,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)		377,700		= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**9,578,000**		
5. Screening Parameters				
Screening Required (Yes = 1; No = 2)		1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		30.14		Ref: CSO Statistics
Construction Cost (Screening)	**$**	**1,808,000**		
6. Stored Volume Treatment				
Volume Requiring Treatment (MG)		30.14		Peak Volume (MG)
Dewatering Time (Days)		2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		15.07		= Peak Vol/DW Time
Construction Cost	**$**	**15,333,339**		
7. Regulator Parameters				
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators		5		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**6,425,000**		
8. Land Acquisition Parameters				
Land Required - Drop Shafts (SF)		12,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)		7,534		250 SF / MGD
Land Required - Odor Control (SF)		18,885		500 SF / 10,000 CFM
Land Required - Screening (SF)		7,534		250 SF / MGD
Land Required - Regulator (SF)		50,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*96,000*		
Land Required Cost (/ SF)	$	2		Ref: Technical Parameters
Land Acquisition Cost	**$**	**192,000**		
			SUBTOTAL CAPITAL COST $	**123,945,339**

Capital Costs

RIVER CROSSING #1 - Microtunnel - N/A			
92 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
	SUBTOTAL CAPITAL COST		**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
92 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
	SUBTOTAL CAPITAL COST		**$ -**

Capital Costs

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
92 Overflows / Year			
1.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
2.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
3.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
4.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
5. CSO 163G001			
Sewer Separation (Remote/Low Flow)	-	3,207,000	Size & Cost by Engineer (from Regional Alts)
6.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
7.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
8.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
9.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
10.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
		SUBTOTAL CAPITAL COST	**$ 3,207,000**

TOTAL CAPITAL COST $ 157,377,339

Operation and Maintenance Costs

Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
TUNNEL STORAGE (A-47 through A-58)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	12.25	$100,254	20	10.910	$1,093,769
	Tunnel Maintenance	Length (ft)	7623	$2,439	50	14.484	$35,330
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	3	$159,050	50	14.484	$2,303,608
	Screening O&M	Flow Rate (MGD)	12.25	$8,478	20	10.910	$92,500
	Odor Control O&M	Capacity (CFM)	153,600	$537,600	20	10.910	$5,865,183
	Reserve / Replace	10% Gravity / 15% Pump					$27,732
			Subtotal Annual O&M	**$808,000**		**Subtotal PW O&M**	**$9,419,000**

Subsystem Components	
A-60 through A-66	$875,000
CSO 163G001	$0
TOTAL ANNUAL O&M	**$1,683,000**
ANNUAL O&M ($MM)	**$1.68**

Operation and Maintenance Costs

Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	30.14	$182,924	20	10.910	$1,995,695
	Tunnel Maintenance	Length (ft)	15265	$4,885	50	14.484	$70,751
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	5	$165,083	50	14.484	$2,390,988
	Screening O&M	Flow Rate (MGD)	30.14	$10,099	20	10.910	$110,184
	Odor Control O&M	Capacity (CFM)	377,700	$1,321,950	20	10.910	$14,422,394
	Reserve / Replace	10% Gravity / 15% Pump					$62,631
			Subtotal Annual O&M	**$1,685,000**		**Subtotal PW O&M**	**$19,053,000**

<u>Subsystem Components</u>

CSO 163G001 Annual O&M	$0

TOTAL ANNUAL O&M	**$1,685,000**
ANNUAL O&M ($MM)	**$1.69**

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AN-1
Structures within Region	#N/A
Model ID	AN-1.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	78
Peak Volume:	7,605,317 ft^3
	56.89 MG
Total Volume:	30,023,039 ft^3
	224.59 MG
Peak Rate:	462.74 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/5/2005 0:52	6402	1/6/2005 3:30	7605316.88	56891.573	0	117.29	13
1/11/2005 7:55	1895	1/12/2005 1:35	2105035.86	15746.721	1	96.43	16
2/14/2005 5:00	4289	2/14/2005 10:05	1946383.09	14559.919	2	48.85	25
1/3/2005 1:12	2488	1/3/2005 13:55	1787290.22	13369.824	3	64.42	21
5/13/2005 22:35	2558	5/14/2005 16:30	1637875.56	12252.128	4	182.83	8
3/27/2005 16:50	3252	3/28/2005 10:15	1214927.68	9088.267	5	70.94	20
4/1/2005 19:21	3144	4/2/2005 6:45	1197075.15	8954.721	6	72.04	19
7/5/2005 16:15	178	7/5/2005 16:55	1185158.17	8865.576	7	462.74	0
8/20/2005 18:15	180	8/20/2005 19:00	1129890.35	8452.145	8	413.49	1
11/29/2005 2:29	1082	11/29/2005 11:15	1096380.59	8201.475	9	110.07	14
1/13/2005 8:50	3461	1/14/2005 2:15	993822.21	7434.287	10	129.50	10
10/24/2005 11:56	2866	10/25/2005 2:40	933744.11	6984.873	11	52.25	23
11/14/2005 21:45	903	11/15/2005 4:15	823530.57	6160.420	12	124.90	11
7/12/2005 19:00	182	7/12/2005 20:05	769380.48	5755.351	13	387.10	2
4/22/2005 15:50	1334	4/23/2005 4:05	618504.39	4626.722	14	308.78	4
7/15/2005 17:25	140	7/15/2005 18:05	550062.40	4114.742	15	332.48	3
9/29/2005 5:20	145	9/29/2005 5:55	440305.21	3293.703	16	270.41	5
5/11/2005 22:35	175	5/11/2005 23:05	433789.71	3244.964	17	148.40	9
2/20/2005 15:24	2029	2/20/2005 20:10	400285.44	2994.335	18	73.40	17
6/11/2005 17:35	124	6/11/2005 18:05	354839.62	2654.378	19	266.95	6
12/15/2005 10:57	986	12/15/2005 14:10	279878.53	2093.631	20	45.22	27
7/26/2005 19:45	518	7/26/2005 20:10	265799.68	1988.315	21	195.93	7
8/29/2005 10:06	403	8/29/2005 13:45	255091.54	1908.212	22	123.01	12
10/21/2005 18:46	1485	10/22/2005 17:15	238870.42	1786.870	23	26.42	32
2/9/2005 14:30	1294	2/9/2005 16:50	224201.78	1677.141	24	72.61	18
5/28/2005 8:40	1155	5/28/2005 9:40	216040.72	1616.093	25	62.37	22
3/23/2005 2:34	1466	3/23/2005 12:55	208892.08	1562.617	26	37.85	30
10/7/2005 7:23	643	10/7/2005 11:00	169022.72	1264.374	27	51.76	24
11/9/2005 19:15	107	11/9/2005 19:45	112076.50	838.388	28	99.25	15
3/24/2005 9:30	804	3/24/2005 10:00	91512.92	684.562	29	43.79	28
5/23/2005 15:20	157	5/23/2005 16:45	73147.98	547.183	30	47.86	26
11/1/2005 14:55	244	11/1/2005 16:45	68336.78	511.193	31	16.48	34
7/25/2005 13:15	359	7/25/2005 13:40	66611.03	498.284	32	42.00	29

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
11/9/2005 4:15	128	11/9/2005 4:40	52805.41	395.011	33	30.74	31
4/20/2005 19:05	330	4/20/2005 19:10	45493.02	340.311	34	15.88	35
11/16/2005 4:06	674	11/16/2005 4:50	39818.03	297.859	35	11.86	36
9/26/2005 6:10	692	9/26/2005 10:10	37968.81	284.026	36	10.10	39
5/20/2005 3:14	473	5/20/2005 7:15	36677.39	274.365	37	7.46	42
12/25/2005 10:50	305	12/25/2005 13:35	34320.90	256.737	38	10.39	37
7/16/2005 9:20	304	7/16/2005 9:45	30683.32	229.527	39	8.83	41
7/17/2005 16:27	93	7/17/2005 16:45	23999.64	179.529	40	20.95	33
4/30/2005 4:30	188	4/30/2005 6:25	17093.22	127.866	41	3.60	52
6/14/2005 19:11	108	6/14/2005 19:20	16818.11	125.808	42	5.25	46
8/8/2005 8:45	167	8/8/2005 10:00	15335.13	114.714	43	6.47	43
2/25/2005 13:45	323	2/25/2005 14:10	14590.20	109.142	44	3.60	53
8/16/2005 6:30	154	8/16/2005 6:40	13580.04	101.585	45	3.90	51
6/6/2005 14:10	67	6/6/2005 14:15	13143.09	98.317	46	10.38	38
6/10/2005 21:25	94	6/10/2005 22:00	13007.14	97.300	47	8.91	40
3/20/2005 4:41	767	3/20/2005 8:15	10406.99	77.849	48	3.25	55
8/26/2005 20:21	140	8/26/2005 21:35	10209.36	76.371	49	4.00	50
4/26/2005 21:40	381	4/27/2005 1:10	9775.51	73.126	50	3.54	54
1/30/2005 12:45	259	1/30/2005 13:20	9670.44	72.340	51	4.92	47
6/3/2005 8:55	112	6/3/2005 9:45	8937.01	66.853	52	3.15	56
1/26/2005 4:35	394	1/26/2005 5:45	7874.11	58.902	53	1.43	58
3/7/2005 22:28	406	3/8/2005 1:35	7790.07	58.274	54	0.90	60
12/26/2005 4:58	709	12/26/2005 6:45	6990.25	52.291	55	0.65	62
8/27/2005 15:20	121	8/27/2005 15:30	6615.03	49.484	56	4.77	48
11/6/2005 14:20	60	11/6/2005 14:35	6489.53	48.545	57	5.70	44
5/24/2005 21:36	98	5/24/2005 22:00	6062.41	45.350	58	4.09	49
5/27/2005 19:00	53	5/27/2005 19:10	5558.73	41.582	59	5.54	45
11/24/2005 8:01	264	11/24/2005 9:30	3675.86	27.497	60	0.58	63
11/23/2005 19:31	208	11/23/2005 20:40	3520.69	26.337	61	0.89	61
6/16/2005 11:22	371	6/16/2005 13:00	2993.15	22.390	62	0.55	65
4/24/2005 15:25	925	4/24/2005 23:15	2307.23	17.259	63	0.20	74
10/24/2005 2:17	128	10/24/2005 3:15	2280.53	17.060	64	0.48	67
10/21/2005 7:21	124	10/21/2005 7:30	1997.71	14.944	65	0.57	64
6/17/2005 1:20	106	6/17/2005 1:35	1582.01	11.834	66	0.45	68
3/12/2005 11:18	204	3/12/2005 11:55	1481.68	11.084	67	0.45	69
4/24/2005 3:22	292	4/24/2005 4:45	1300.99	9.732	68	0.21	73
7/18/2005 7:55	53	7/18/2005 8:30	1250.83	9.357	69	1.05	59
7/21/2005 14:35	15	7/21/2005 14:45	1156.08	8.648	70	2.13	57
12/9/2005 4:06	93	12/9/2005 4:35	1144.28	8.560	71	0.36	71
11/8/2005 15:03	75	11/8/2005 15:15	1126.45	8.426	72	0.50	66
3/11/2005 13:48	140	3/11/2005 14:15	760.24	5.687	73	0.27	72
5/7/2005 13:25	54	5/7/2005 13:35	609.07	4.556	74	0.40	70
2/8/2005 6:00	128	2/8/2005 7:30	525.08	3.928	75	0.15	75
9/17/2005 0:22	91	9/17/2005 1:30	397.37	2.972	76	0.13	76
12/31/2005 22:58	61	12/31/2005 23:05	136.07	1.018	77	0.04	77

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AN-1
Structures within Region	#N/A
Model ID	AN-1.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	78	
Peak Volume:	7,605,317	ft^3
	56.89	MG
Total Volume:	30,023,039	ft^3
	224.59	MG
Peak Rate:	462.74	cfs

Figure 1 - AN-1 Region CSO Volume

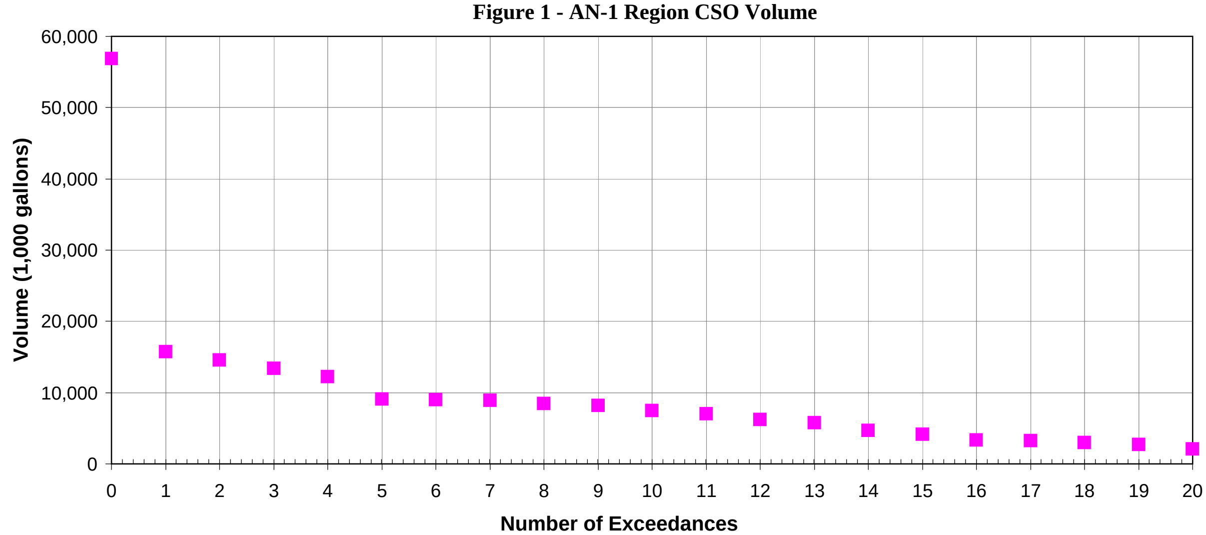
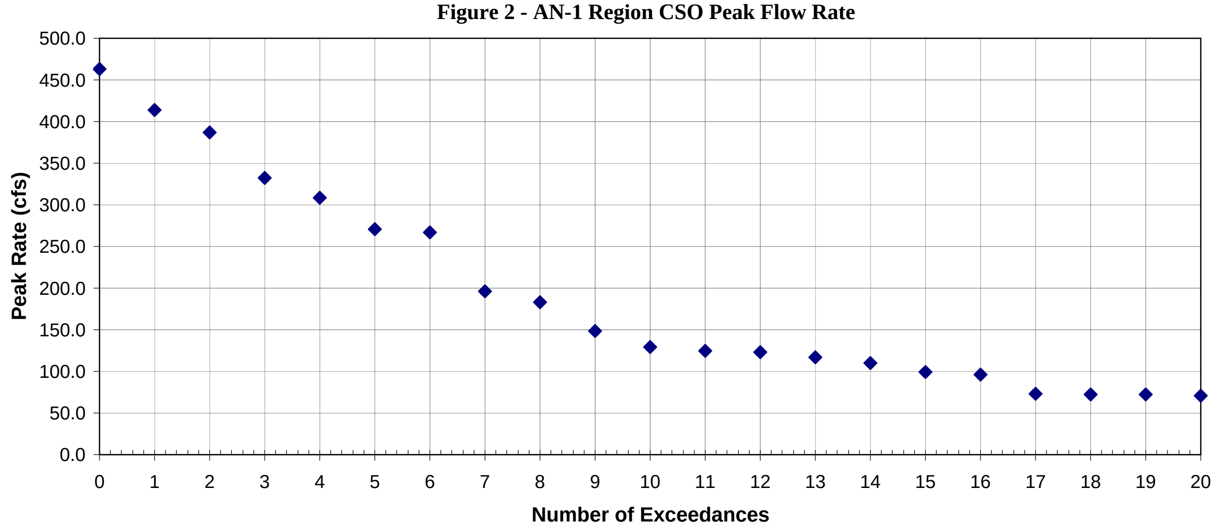


Figure 2 - AN-1 Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AN-2
Structures within Region	#N/A
Model ID	AN-2.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	92
Peak Volume:	25,882,463 ft^3
	193.61 MG
Total Volume:	89,412,989 ft^3
	668.85 MG
Peak Rate:	892.08 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/3/2005 1:12	9268	1/6/2005 3:45	25882462.72	193613.762	0	243.63	11
2/14/2005 5:00	5339	2/14/2005 10:00	6570840.23	49153.170	1	109.43	26
1/11/2005 7:55	2341	1/12/2005 1:35	5862183.99	43852.067	2	201.75	16
5/13/2005 22:35	2664	5/14/2005 16:30	4399628.71	32911.423	3	374.27	7
4/1/2005 19:21	3186	4/2/2005 6:45	4028963.00	30138.658	4	146.84	21
3/27/2005 11:27	3574	3/28/2005 10:15	3903169.29	29197.658	5	147.85	20
10/24/2005 11:56	2866	10/25/2005 3:50	3418200.32	25569.847	6	108.73	27
11/29/2005 2:29	1959	11/29/2005 11:15	3040115.17	22741.581	7	215.20	15
8/20/2005 18:15	418	8/20/2005 19:00	2613347.25	19549.144	8	770.08	1
1/13/2005 8:50	3462	1/14/2005 2:15	2525124.85	18889.196	9	222.57	14
7/5/2005 10:05	814	7/5/2005 16:55	2474731.01	18512.225	10	892.08	0
4/22/2005 15:45	4240	4/23/2005 4:05	1993922.52	14915.537	11	497.44	3
11/14/2005 21:45	995	11/15/2005 4:15	1977093.88	14789.651	12	194.63	17
2/20/2005 11:42	2252	2/20/2005 20:10	1808494.68	13528.444	13	148.99	18
1/1/2005 0:10	140	1/1/2005 0:15	1448823.49	10837.924	14	364.93	8
7/15/2005 16:45	394	7/15/2005 18:00	1431919.67	10711.475	15	544.01	2
3/23/2005 2:34	2691	3/23/2005 12:55	1365643.30	10215.695	16	89.35	29
12/15/2005 10:50	2094	12/15/2005 14:10	1304564.37	9758.794	17	93.37	28
7/12/2005 19:00	274	7/12/2005 20:05	1102673.62	8248.550	18	479.22	4
5/11/2005 22:25	334	5/11/2005 23:00	1042080.80	7795.285	19	280.11	10
10/21/2005 18:46	1667	10/22/2005 17:15	979456.05	7326.821	20	70.58	30
9/29/2005 5:20	432	9/29/2005 5:55	956278.68	7153.443	21	465.65	5
5/28/2005 8:35	1160	5/28/2005 9:30	923801.25	6910.495	22	140.34	22
2/9/2005 14:25	1937	2/9/2005 16:50	919343.58	6877.150	23	148.76	19
6/11/2005 15:40	410	6/11/2005 18:00	771992.74	5774.892	24	462.65	6
8/29/2005 10:06	622	8/29/2005 13:45	673321.77	5036.784	25	235.43	12
7/26/2005 19:45	519	7/26/2005 20:10	592118.87	4429.345	26	339.58	9
10/7/2005 7:23	746	10/7/2005 11:00	591619.81	4425.612	27	118.50	23
11/16/2005 4:10	903	11/16/2005 7:30	386714.56	2892.818	28	40.90	35
11/1/2005 14:55	464	11/1/2005 16:30	332579.78	2487.863	29	56.43	33
5/23/2005 15:20	469	5/23/2005 16:45	314076.64	2349.450	30	113.33	24
11/9/2005 19:15	268	11/9/2005 19:45	308857.37	2310.408	31	226.90	13
4/20/2005 19:05	469	4/20/2005 19:50	277084.99	2072.734	32	34.09	38

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
5/20/2005 3:10	690	5/20/2005 8:40	256690.68	1920.175	33	24.71	43
9/26/2005 5:45	718	9/26/2005 9:45	246273.70	1842.250	34	32.63	39
7/16/2005 9:20	477	7/16/2005 9:30	235303.06	1760.185	35	66.17	31
12/25/2005 10:50	564	12/25/2005 13:30	228613.98	1710.147	36	39.61	36
8/8/2005 8:45	344	8/8/2005 9:50	223371.21	1670.928	37	65.46	32
7/25/2005 13:15	359	7/25/2005 13:40	208311.12	1558.271	38	109.63	25
3/7/2005 22:28	961	3/8/2005 1:55	151024.09	1129.736	39	10.82	48
4/30/2005 4:30	893	4/30/2005 7:10	137283.72	1026.951	40	6.69	54
12/26/2005 4:58	900	12/26/2005 11:30	124427.37	930.779	41	6.84	53
3/20/2005 4:41	1013	3/20/2005 8:45	119641.50	894.978	42	4.55	59
6/3/2005 8:50	323	6/3/2005 9:35	110577.97	827.178	43	32.54	40
1/30/2005 12:15	435	1/30/2005 13:25	108515.98	811.754	44	25.77	42
2/25/2005 13:35	634	2/25/2005 14:10	97776.48	731.417	45	5.63	55
11/9/2005 4:15	239	11/9/2005 4:30	97289.85	727.777	46	49.90	34
7/17/2005 16:17	342	7/17/2005 16:45	87326.75	653.248	47	39.13	37
6/14/2005 19:10	230	6/14/2005 20:00	68472.51	512.209	48	20.35	44
1/26/2005 4:35	529	1/26/2005 5:45	67923.57	508.102	49	5.57	56
2/26/2005 10:16	677	2/26/2005 15:00	64936.53	485.758	50	2.27	68
3/12/2005 11:01	563	3/12/2005 15:45	64891.72	485.423	51	2.71	66
11/24/2005 8:01	422	11/24/2005 8:15	48631.74	363.790	52	3.83	62
8/26/2005 20:21	193	8/26/2005 21:15	36609.72	273.859	53	13.17	45
8/16/2005 6:30	305	8/16/2005 8:15	33333.00	249.348	54	4.80	58
8/27/2005 15:20	184	8/27/2005 15:45	25887.44	193.651	55	11.29	47
2/27/2005 10:56	367	2/27/2005 13:55	21931.65	164.060	56	1.34	73
4/26/2005 21:40	382	4/27/2005 1:10	19391.59	145.059	57	4.04	61
3/5/2005 11:02	332	3/5/2005 14:10	18495.59	138.356	58	1.21	76
2/5/2005 10:56	313	2/5/2005 13:55	17908.95	133.968	59	1.25	74
2/6/2005 10:56	317	2/6/2005 13:50	17634.19	131.913	60	1.22	75
7/18/2005 7:50	59	7/18/2005 8:00	17487.65	130.816	61	31.44	41
3/6/2005 10:57	315	3/6/2005 13:50	17273.12	129.212	62	1.20	77
3/19/2005 11:01	312	3/19/2005 13:50	16699.04	124.917	63	1.16	79
10/21/2005 7:21	203	10/21/2005 9:05	16334.04	122.187	64	1.92	71
3/13/2005 11:11	308	3/13/2005 13:50	15172.36	113.497	65	1.08	80
6/10/2005 19:55	184	6/10/2005 22:00	14880.42	111.313	66	8.91	51
6/6/2005 9:30	474	6/6/2005 14:15	14274.20	106.778	67	10.38	49
5/7/2005 13:25	189	5/7/2005 15:00	13968.64	104.492	68	1.96	70
3/26/2005 11:32	297	3/26/2005 13:55	12289.25	91.930	69	0.94	82
2/22/2005 9:01	262	2/22/2005 11:25	11173.02	83.580	70	1.03	81
9/23/2005 2:40	30	9/23/2005 3:00	10632.65	79.538	71	12.37	46
2/13/2005 11:42	289	2/13/2005 13:55	10493.89	78.500	72	0.86	83
2/12/2005 11:52	283	2/12/2005 14:00	9595.32	71.778	73	0.83	84
2/19/2005 11:56	285	2/19/2005 14:15	9558.99	71.506	74	0.82	85
11/6/2005 13:55	86	11/6/2005 14:00	9208.32	68.883	75	8.80	52
6/16/2005 11:20	373	6/16/2005 12:45	7671.60	57.387	76	3.38	63
11/23/2005 19:31	208	11/23/2005 20:00	7511.42	56.189	77	2.66	67
8/13/2005 20:10	26	8/13/2005 20:15	7112.86	53.208	78	9.43	50
5/27/2005 19:00	130	5/27/2005 19:10	6696.09	50.090	79	5.54	57
5/24/2005 21:36	98	5/24/2005 22:00	6062.49	45.350	80	4.09	60
12/31/2005 22:58	62	12/31/2005 23:05	4097.92	30.654	81	3.12	64
10/24/2005 2:17	128	10/24/2005 3:15	4053.81	30.325	82	1.37	72
11/8/2005 15:03	75	11/8/2005 15:15	2584.30	19.332	83	2.74	65
6/17/2005 1:20	106	6/17/2005 1:35	2199.89	16.456	84	1.18	78
1/22/2005 13:09	134	1/22/2005 14:20	1289.13	9.643	85	0.28	87

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
3/11/2005 13:48	373	3/11/2005 14:15	1190.84	8.908	86	0.27	88
7/21/2005 14:35	15	7/21/2005 14:45	1156.12	8.648	87	2.13	69
12/9/2005 4:06	93	12/9/2005 4:35	1144.20	8.559	88	0.36	86
2/24/2005 20:36	76	2/24/2005 21:15	550.36	4.117	89	0.16	89
2/8/2005 6:00	128	2/8/2005 7:30	525.20	3.929	90	0.15	90
9/17/2005 0:22	91	9/17/2005 1:30	397.48	2.973	91	0.13	91

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AN-2
Structures within Region	#N/A
Model ID	AN-2.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	92	
Peak Volume:	25,882,463	ft^3
	193.61	MG
Total Volume:	89,412,989	ft^3
	668.85	MG
Peak Rate:	892.08	cfs

Figure 1 - AN-2 Region CSO Volume

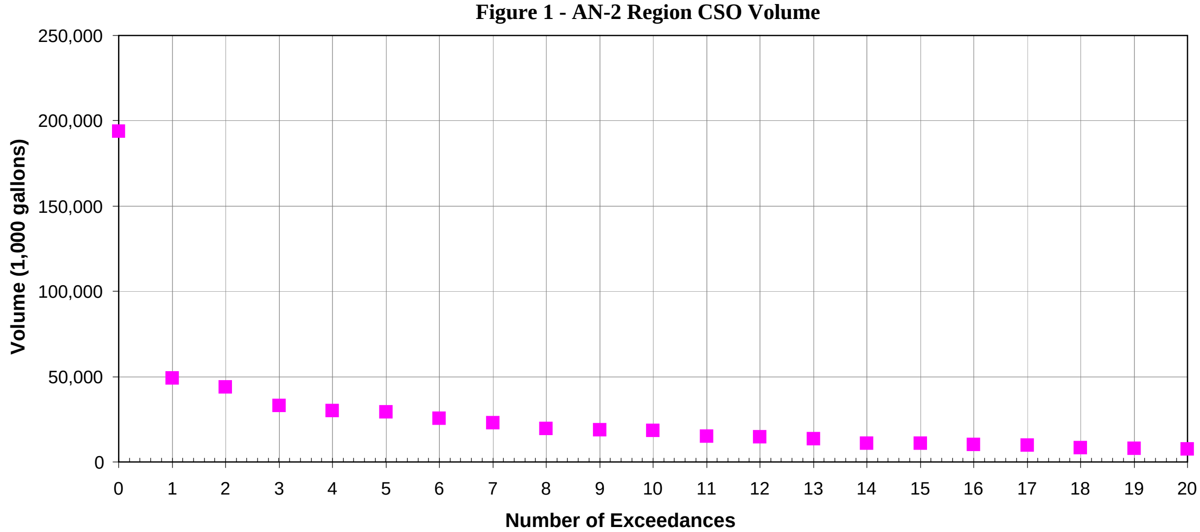
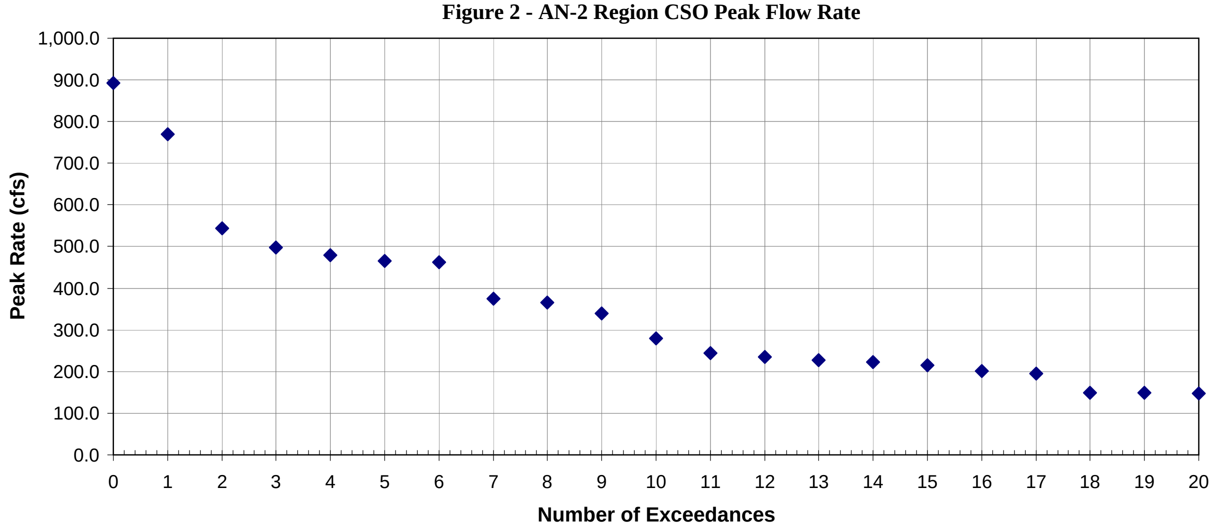


Figure 2 - AN-2 Region CSO Peak Flow Rate



F.1 ALLEGHENY NORTH SUBSYSTEM

Description of Subsystem

The Allegheny North Subsystem is located along the northern bank of the Allegheny River between the CSO structures A-47 and A-66. Also included in this subsystem is CSO 163G001 which lies on the northern end of the East Street Sewershed at the boundary between the City of Pittsburgh and Ross Township. Control of CSOs within this Subsystem will be based upon Tunnel Storage, in combination with the highest ranked outfall groupings in the areas not served by the Tunnel. This combination serves to control CSOs originating from the following outfalls and Regions:

- A-47 to A-59A Region
- A-60 to A-66 Region
- CSO 163G001

All of these Regions currently convey overflows from each of the respective ALCOSAN diversion chambers to the Allegheny River.

The entire area that is encompassed in this alternative includes approximately 3,125 acres of residential, business and commercial users.

Description of Alternatives

In an effort to determine the most effective combination of controls for this Subsystem, two variations were developed and evaluated. They are labeled AN-1 and AN-2. These subsystem variations were based upa a capture level of 4 CSO events per year. A brief description of each is given below.

Alternative AN-1

Alternative AN-1 is based upon Tunnel AN-1 having an approximate length of 7,500 feet. *Attachment 1 – Subsystem Alternative AN-1 Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and approximate location of the tunnel. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Allegheny North system will be controlled using the highest ranked CSO control technologies that were identified during the Outfall Specific and Regional Alternatives Evaluation process. Detailed descriptions of these Outfall Specific and Regional Alternatives may be found in Appendices D and E.

Tunnel AN-1 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 56.89 MG to 8.95 MG for control levels of 0 to 6 overflow events, respectively. *Figure 1 – AN-1 Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

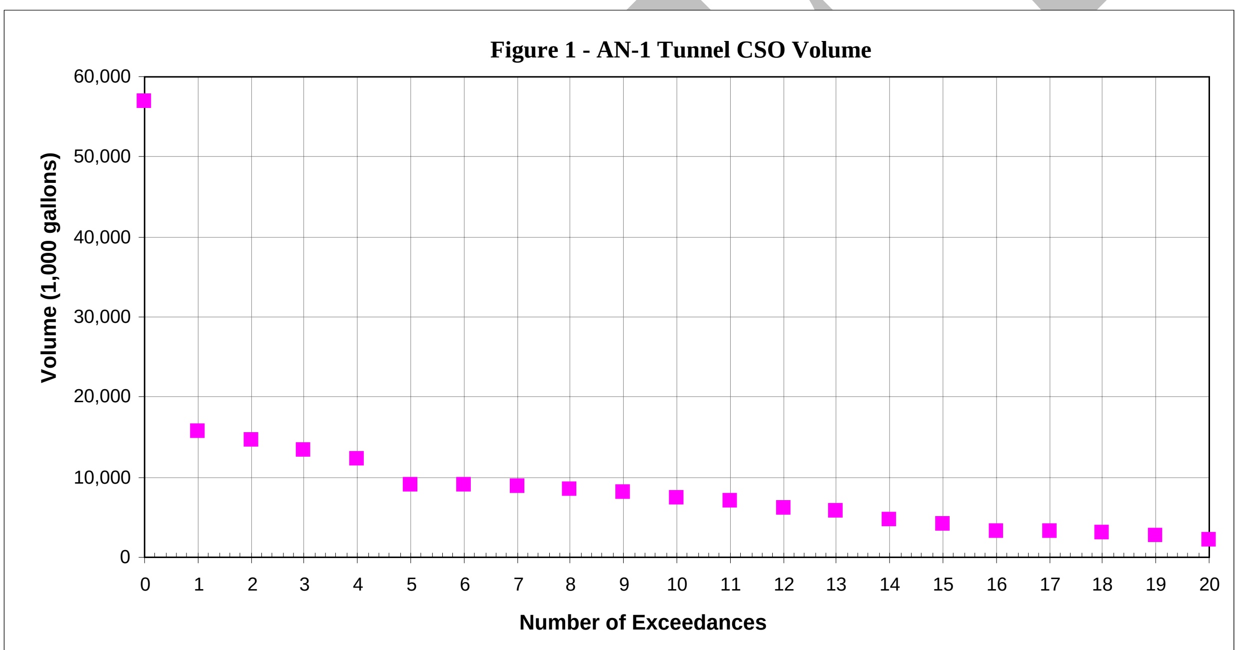


Figure 1 - AN-1 Tunnel CSO Volume

Table 1 – Alternative AN-1 Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation, sewershed characteristics, and the CSO control technology for each outfall and/or Region not controlled by the tunnel.

Table 1: Alternative AN-1 Characteristics

Outfall Grouping/Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
A-47 to A-59A Region	A-47	1,813	78	Tunnel AN-1
	A-48			
	A-49			
	A-50			
	A-51			
	A-56			
	A-58			
	CSO 009E001			
	A-59			
	A-59A			
A-60 to A-66 Region	A-60	1,291	93	Screening and Disinfection
	A-61			
	A-62			
	A-63			
	A-64			
	A-65			
	A-66			
CSO 163G001	CSO 163G001	21	75	Remote/Low Flow (Sewer Separation)

<u>Tunnel AN-1</u>

The Allegheny North Tunnel AN-1 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers A-47 to A-59A. A pump station would be required to dewater the tunnel storage volume into either the ACLSOAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 12 MGD for 4 overflows. Assuming a tunnel length of approximately 1.4 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 18.5 feet.

Other important components of Tunnel AN-1 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 2 – Tunnel AN-1 Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 2: Tunnel AN-1 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AN-1	Near A-47	A-47, A-48	176.94	570	90
AN-2	Near A-50	A-49, A-50, A-51	99.83	895	66
AN-3	Near CSO 009E001	A-56, A-58, A-59, A-59A, CSO 009E001	310.82	2,185	120

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM to the west of A-47 and near A-59A. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development; as well as natural features such as the Ohio and Allegheny Rivers. Approximately 2.6 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 2, Subsystem Alternative AN-1, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

A-60 to A-66 Region portion of Alternative AN-1 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control measures.

CSO 163G001 portion of Alternative AN-1 will be controlled via Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

Alternative AN-2

Alternative AN-2 is based upon Tunnel AN-2 having an approximate length of 15,000 feet. *Attachment 3 – Subsystem Alternative AN-2 Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and approximate location of the tunnel. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Allegheny North system will be controlled using the highest ranked CSO control technologies that were identified during the Outfall Specific and Regional Alternatives Evaluation process. Detailed descriptions of these Outfall Specific and Regional Alternatives may be found in Appendices D and E.

Tunnel AN-2 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 193.60 MG to 25.57 MG for control levels of 0 to 6 overflow events, respectively. *Figure 2 – AN-2 Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

Figure 2 - AN-2 Tunnel CSO Volume

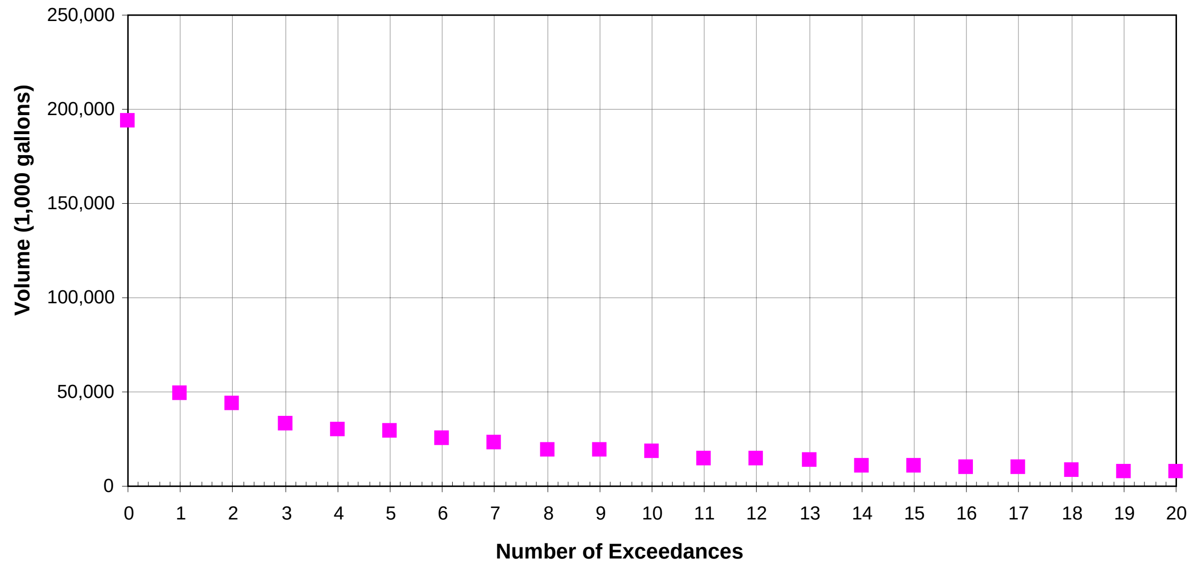


Table 3 – Alternative AN-2 Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation, sewershed characteristics, and the CSO control technology for each outfall and/or Region not controlled by the tunnel.

Table 3: Alternative AN-2 Characteristics

Outfall Grouping/Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
A-47 to A-59A Region and A-60 to A-66 Region	A-47	3,104	92	Tunnel AN-2
	A-48			
	A-49			
	A-50			
	A-51			
	A-56			
	A-58			

Outfall Grouping/Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
	CSO 009E001			
	A-59			
	A-59A			
	A-60			
	A-61			
	A-62			
	A-63			
	A-64			
	A-65			
	A-66			
CSO 163G001	CSO 163G001	21	75	Remote/Low Flow (Sewer Separation)

Tunnel AN-2

The Allegheny North Tunnel AN-2 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers A-47 to A-66. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 30 MGD for 4 overflows. Assuming a tunnel length of approximately 2.9 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 20.5 feet.

Other important components of Tunnel AN-2 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 4 – Tunnel AN-2 Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 4: Tunnel AN-2 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AN-1	Near A-47	A-47, A-48	176.94	570	90
AN-2	Near A-50	A-49, A-50, A-51	99.83	895	66
AN-3	Near CSO 009E001	A-56, A-58, A-59, A-59A, CSO 009E001	310.82	2,185	120
AN-4	Near A-60	A-60, A-61, A-62	380.38	3,255	120
AN-5	Near A-64	A-63, A-64, A-65, A-66	161.73	2,675	90

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM to the west of A-47 and near A-66. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development; as well as natural features such as the Ohio and Allegheny Rivers. Approximately 6.4 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 4, Subsystem Alternative AN-2, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>CSO 163G001</u> portion of Alternative AN-2 will be controlled via Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall.

Details for the CSO volume and peak rate flow, and the results of the technology scoring and costs for the outfall that is not included in the tunnel can be found in the Outfall Specific and Consolidated Outfall Analysis appendix.

Alternative Evaluation Results

Table 5 – Allegheny North Subsystem Alternative Costs, illustrates the planning level capital, O&M and present worth costs associated with alternatives AN-1 and AN-2, when sized for 4 untreated overflows per year.

Table 5: Allegheny North Subsystem Alternative Costs

Subsystem	Capital Cost (MM$)	Annual O&M Cost (MM$)	PW Cost (MM$)
AN-1	126.7	1.7	145.7
AN-2	157.4	1.7	176.4

For the purpose of this Feasibility Study, the above alternatives were further evaluated based in a combination of their economic, environmental, implementation, and operational impacts over a range of CSO control levels corresponding to 4 untreated overflows per year.

Attachment 5 – Allegheny North Subsystem Alternatives Scoring Sheet illustrates the composite scoring of economic, environmental, implementation, and operational evaluation factors for control levels of 4 overflows per year. Complete details of the economic evaluation and the composite scoring of economic, environmental, implementation, and operational evaluation factors can be found in Appendix F.

Recommendations

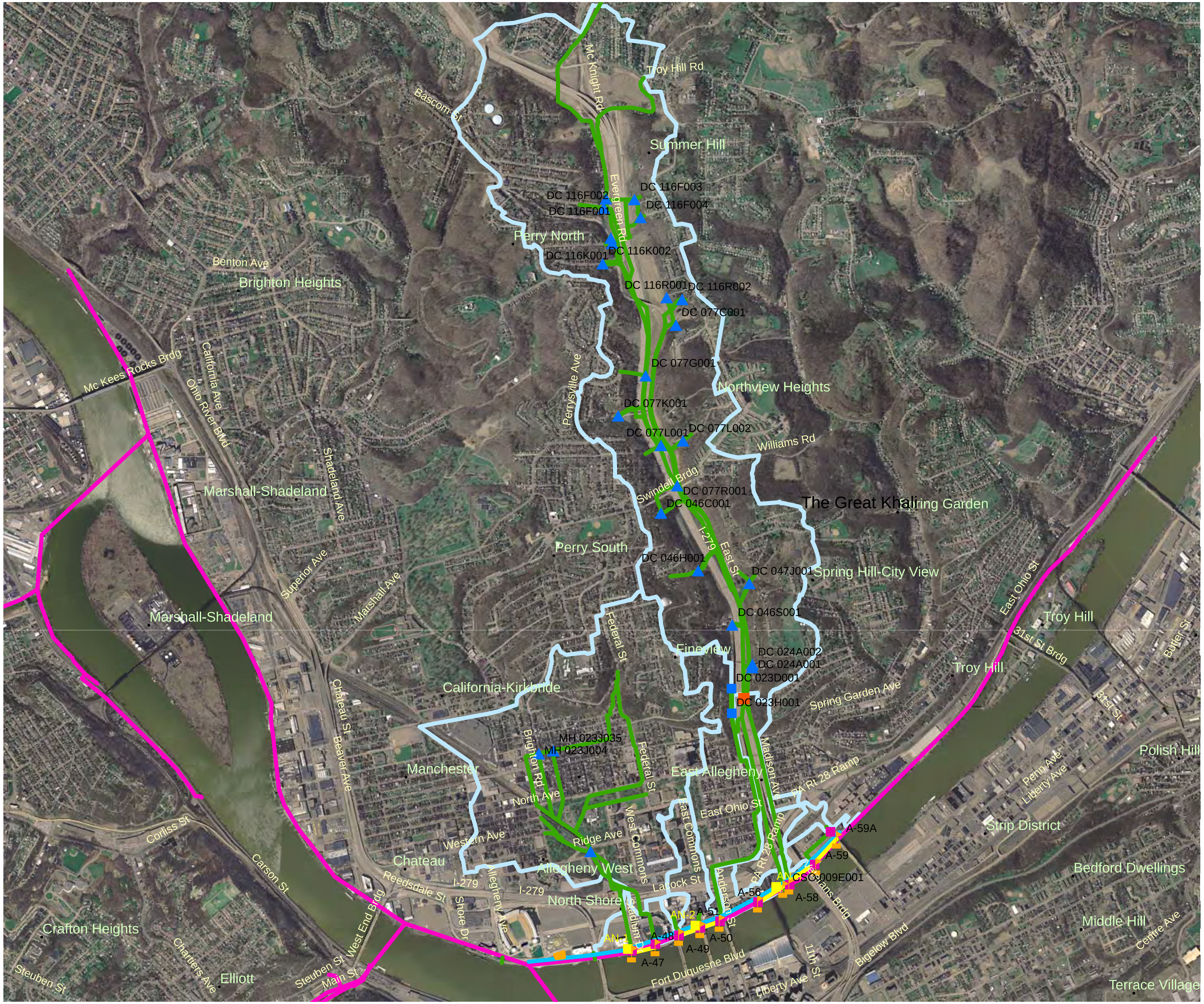
It is recommended that the following alternative be carried forward as part of the overall System-Wide alternative.

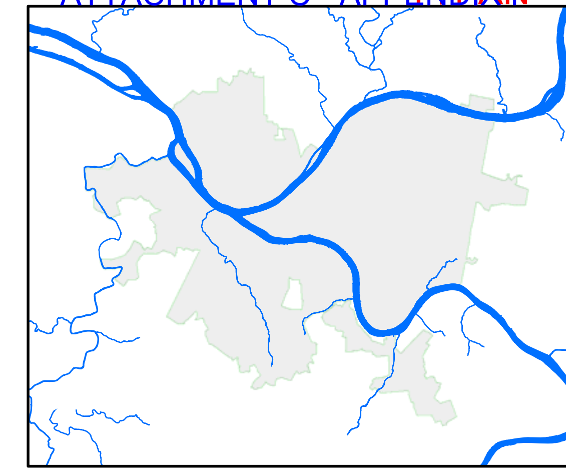
- AN-2. This alternative resulted in the highest score for control level of 4 events per year.

Significant Issues

Some issues exist with the siting of a tunnel. It appears that there is some space for the facilities associated with the tunnel, however, there is significant infrastructure at intermittent locations along the entire length of the alignment. Detailed geotechnical studies would have to be completed to determine the suitability of the underlying subsurface conditions for tunnel construction. In addition, construction of drop shafts and the consolidation sewers will be a significant endeavor considering the congested infrastructure and natural features that exist in the area where the sewers would be constructed. In addition to the geotechnical studies, permitting and land acquisition would determine the final location of these facilities if this alternative is selected for implementation. Any potential issues associated with the outlier outfalls are presented in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

ATTACHMENT C - APPENDIX F





Legend

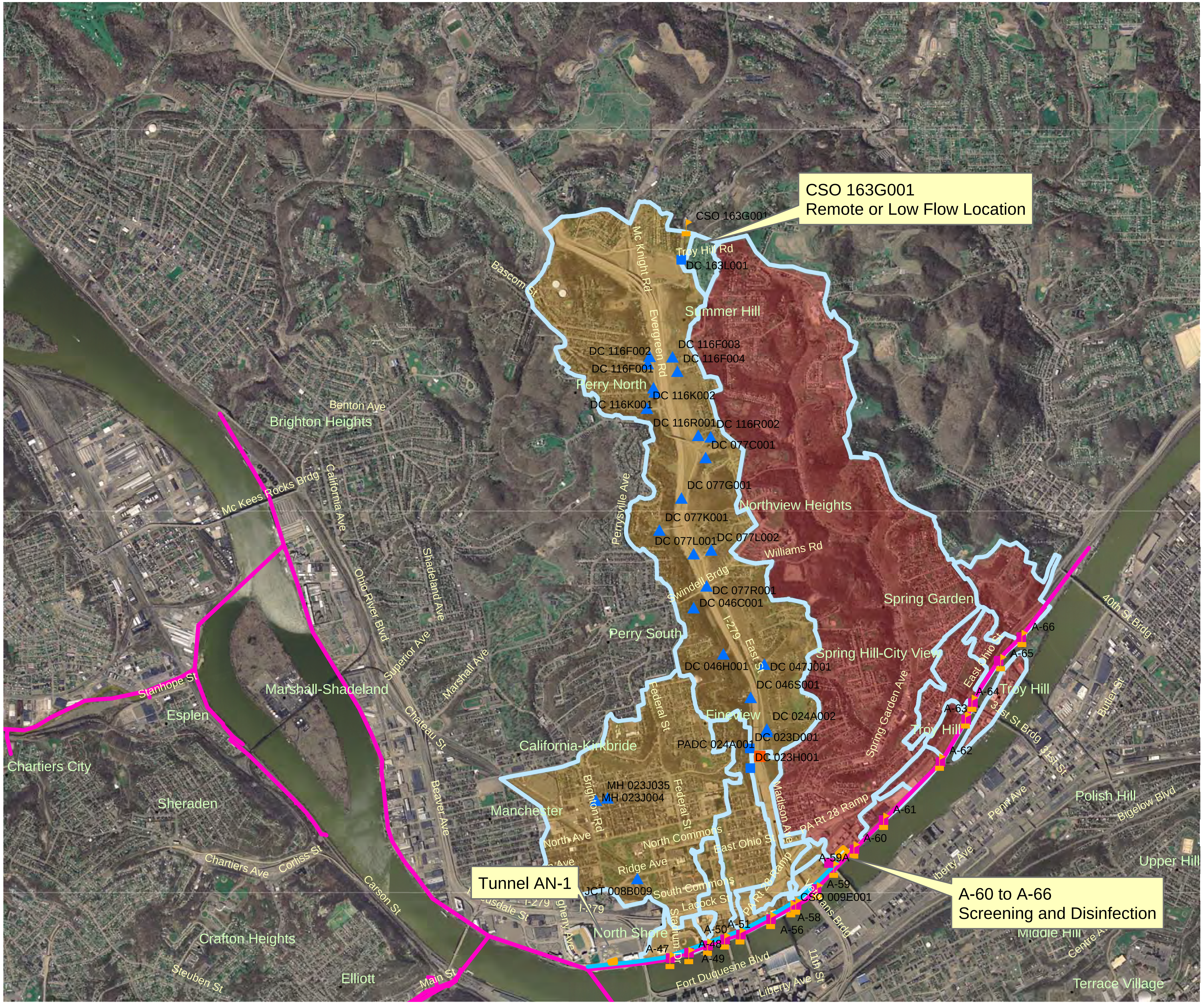
- Sewershed Boundary
- Facility Boundary
- Tunnel AN-1
- Consolidation Pipe
- ALCOSAN Interceptor
- Trunk Sewer
- ALCOSAN Diversion Structure
- PENNDOT Diversion Chamber
- PWSA Flow Divider
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

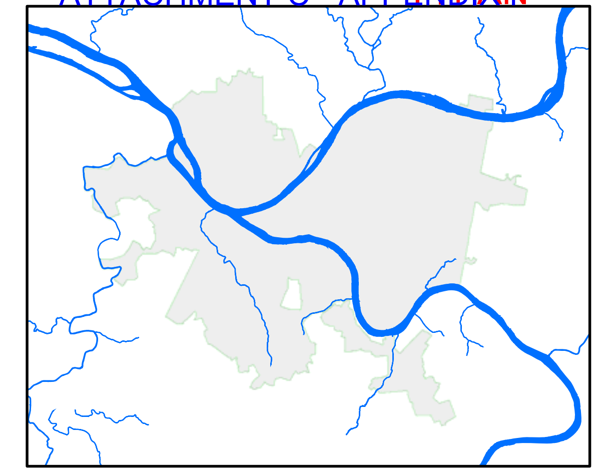
3,000 0 3,000
Feet

Attachment 1
Subsystem Alternative AN-1 Tunnel Portion

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

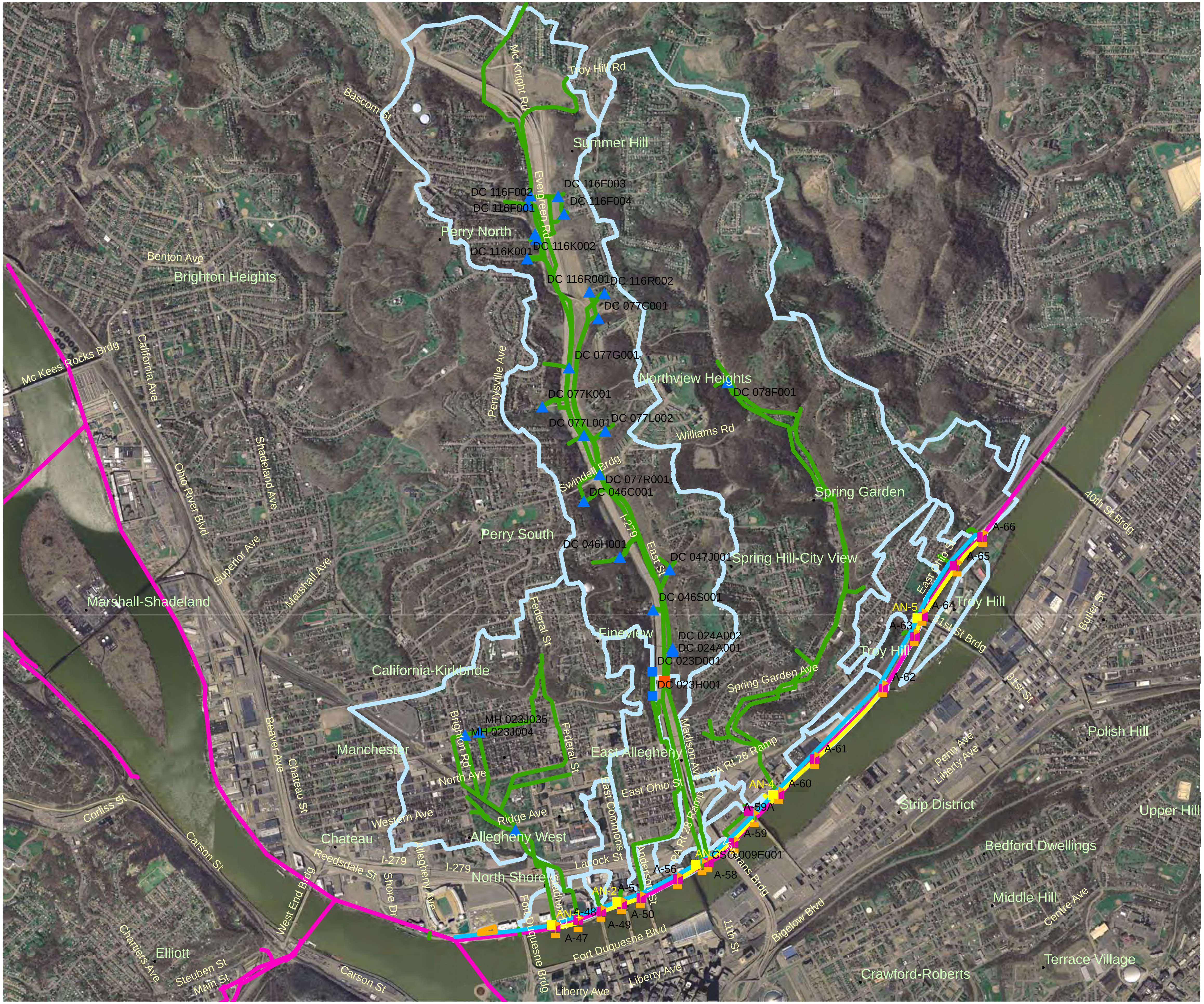
- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Screening and Disinfection
- Remote or Low Flow Location
- Tunnel AN-1
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PENNDOT Diversion Chamber
- PWSA Flow Divider
- PWSA Diversion Structure
- Combined Sewer Outfall

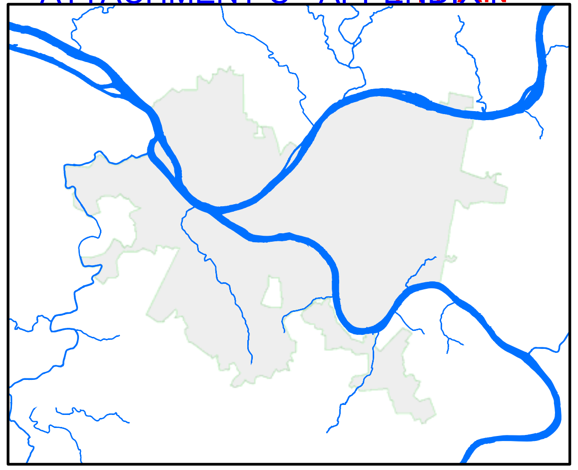
3,000 0 3,000 Feet

Attachment 2
Subsystem
Alternative AN-1

CSO Controls Alternatives

PWSA THE PITTSBURGH WATER & SEWER AUTHORITY Quality Water Quality Service





Legend

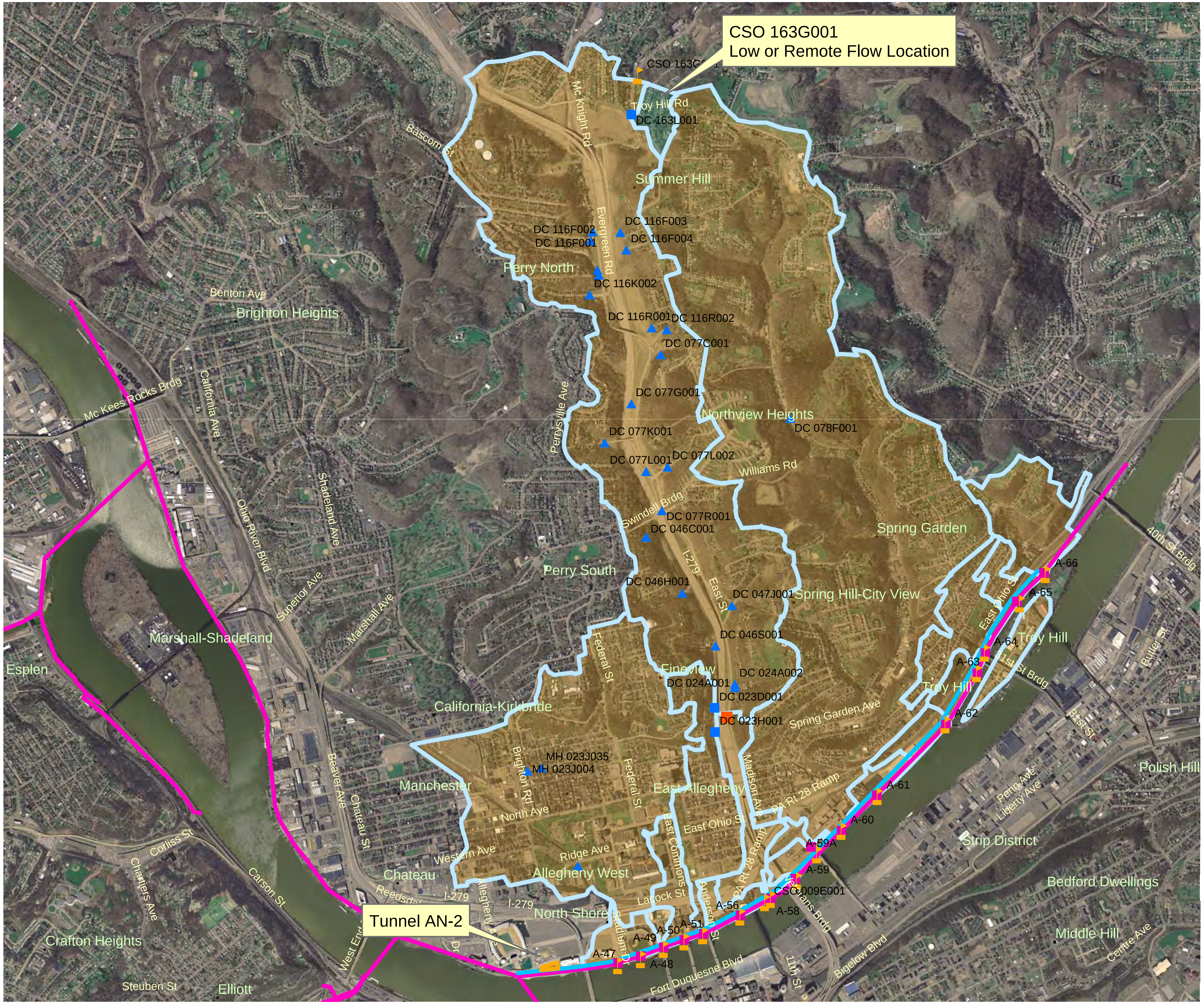
- Sewershed Boundary
- Facility Boundary
- Tunnel AN-2
- Consolidation Pipe
- ALCOSAN Interceptor
- Trunk Sewer
- ALCOSAN Diversion Structure
- PENNDOT Diversion Chamber
- Flow Divider
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

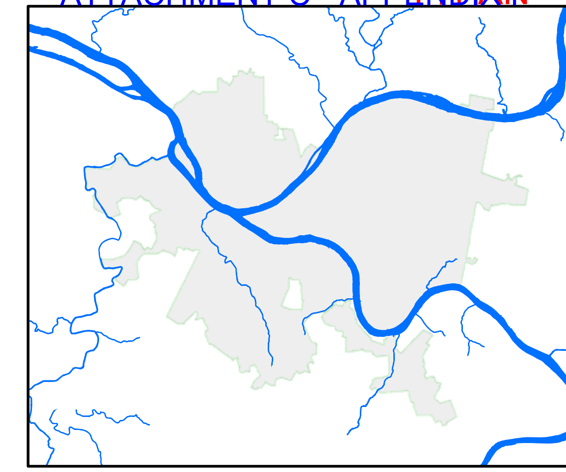
3,000 0 3,000
Feet

Attachment 3
Subsystem
Alternative AN-2
Tunnel Portion

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Low or Remote Flow Location
- Tunnel AN-2
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PENNDOT Diversion Chamber
- Flow Divider
- PWSA Diversion Structure
- Combined Sewer Outfall

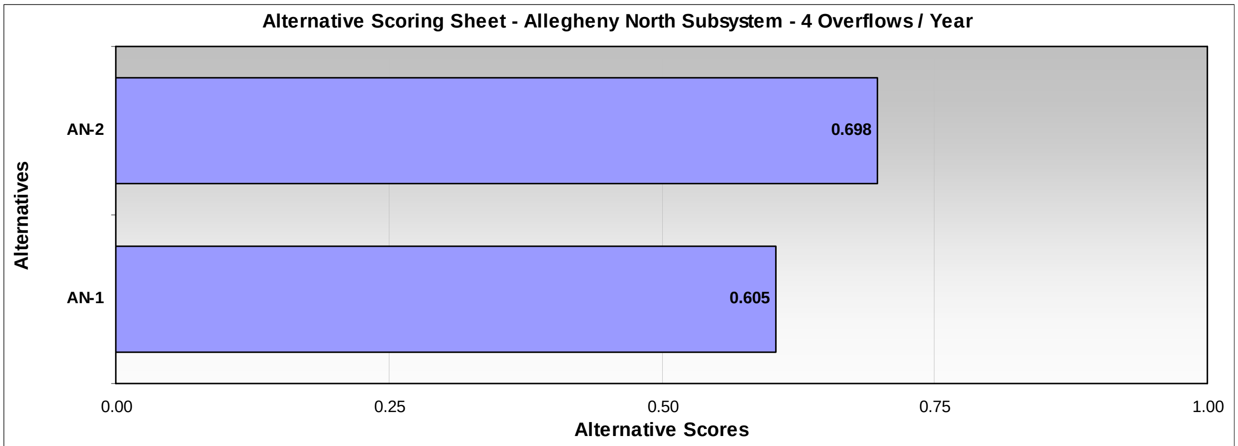
3,000 0 3,000
Feet

Attachment 4 Subsystem Alternative AN-2

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

Attachment 5 – Allegheny North Subsystem Alternative Scoring Sheet



Alternative Menu

AS-1				
Tunnel				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ -
TUNNEL STORAGE (A-01 thru A-37)				
	A-01 thru A-15 Downtown Allegheny, A-16 thru A-21 Strip District, A-22 and A-23 Two Mile Run, A-25 thru A-37 Lawrenceville			
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Heth's Run (A-38 thru A-41)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	122.3	Integrated Outfalls	$ 44.0	$ 38,148,000
Negley Run (A-42/42A)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	320.5	Screening & Disinfection	$ 85.9	$ 69,373,000

Alternative Menu

AS-2				
Tunnel				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ -
TUNNEL STORAGE (AS-1 Outfalls plus A-38 thru A-41)				
AS-1 Outfalls plus A-38 thru A-41 Heth's Run				
RIVER CROSSING #1 - Microtunnel				
N/A				
RIVER CROSSING #2 - Microtunnel				
N/A				
RIVER CROSSING #3 - Microtunnel				
N/A				
RIVER CROSSING #4 - Microtunnel				
N/A				
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Heth's Run (A-38 thru A-41)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	122.3	Integrated Outfalls		
Negley Run (A-42/42A)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	320.5	Screening & Disinfection	$ 85.9	$ 69,373,000

Alternative Menu

AS-3				
Tunnel				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ -
TUNNEL STORAGE (AS-1 Outfalls plus A-38 thru A-41 and A-42)				
AS-2 Outfalls plus A-42/42A Negley Run				
RIVER CROSSING #1 - Microtunnel				
N/A				
RIVER CROSSING #2 - Microtunnel				
N/A				
RIVER CROSSING #3 - Microtunnel				
N/A				
RIVER CROSSING #4 - Microtunnel				
N/A				
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Heth's Run (A-38 thru A-41)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	122.3	Integrated Outfalls		
Negley Run (A-42/42A)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	320.5	Screening & Disinfection		

Alternative:	AS-1	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	5
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	AS-1	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	3
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	AS-1	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	3
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	AS-1	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	1
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	AS-1	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	2
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	AS-1	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	1
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	AS-1	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	AS-1	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	AS-1	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	3
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	AS-1	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	AS-1	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	3
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	AS-1	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	3
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Alternative:	AS-1	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team
Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	AS-2	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	5
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	AS-2	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	3
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	AS-2	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	3
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	AS-2	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	3
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	AS-2	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	3
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	AS-2	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Alternative:	AS-2	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	AS-2	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	AS-2	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	3
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	AS-2	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	AS-2	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	3
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	AS-2	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	2
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	AS-2	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Alternative:	AS-3	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	5
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	AS-3	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	4
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	AS-3	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	4
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	AS-3	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	3
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	AS-3	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	3
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	AS-3	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	5
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	AS-3	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	3
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	AS-3	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	AS-3	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	4
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Alternative:	AS-3	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	AS-3	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	5
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	AS-3	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	3
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Alternative:	AS-3	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Total Score

Alternative:	AS-1		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	1	0.00	0.062	0.000
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	1	0.00	0.053	0.000
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.543**

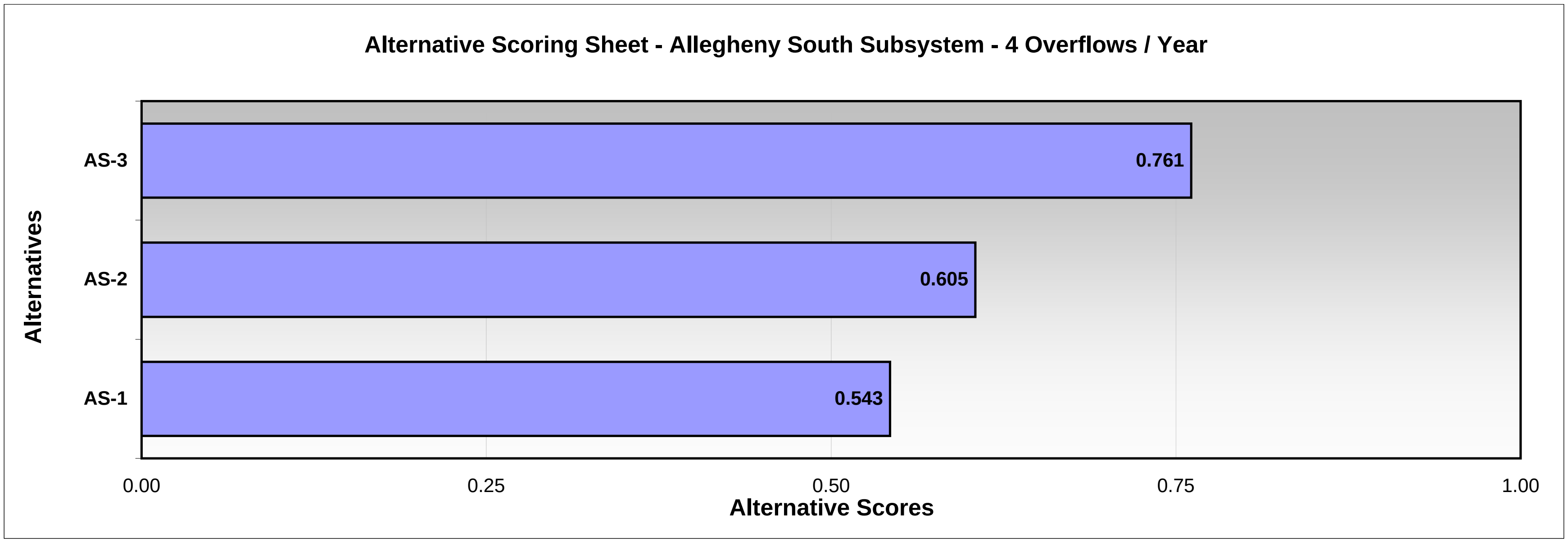
Total Score

Alternative:	AS-2		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.605**

Total Score

Alternative:	AS-3		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	5	1.00	0.053	0.053
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.761**

Alternative Scoring Sheet



RESULTS SUMMARY			
Number of Events / Year	4		
Number of Overflows / Year	92		
Peak Volume	6,097,571	CF	
	45.61	MG	
Total Volume	129,983,762	CF	
	972.28	MG	
Peak Rate	1,039.56	CFS	
	671.84	MGD	

CONSOLIDATION SEWERS - Total		
92 Overflows / Year		
SUBTOTAL CAPITAL COST	**$**	**-**

TUNNEL STORAGE (A-01 thru A-37)			
92 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	45.61	6,098,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	57.01	7,623,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	19		Input by Engineer
Tunnel Volume / Ft length (CF)	283.39		Ref: Tunnel diameter
Tunnel Length (Ft)	26,900		= Req'd Fac Vol / Vol per Ft Length; Target length is 27,000 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	13	13	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MDG)	34	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**138,915,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	45.61	70.57	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	46		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	6.1	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	150		Input by Engineer
Construction Cost (PS / Force Main) $	**11,767,000**	**$ 83,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	79.97		Peak Flow / # drop shaft
Diameter (In)	66		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	3,525		75' per drop shaft
Average Depth (Ft)	20		Input by Engineer
Construction Cost (Consolidation Pipe) $	**4,416,000**	**$ -**	Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	11,435,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	571,750		= ACH x Volume / 60
Construction Cost (Odor Control) $	**13,256,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	45.61		Ref: CSO Statistics
Construction Cost (Screening) $	**2,524,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	45.61		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	22.80		= Peak Vol/DW Time
Construction Cost $	**19,113,556**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	47		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**60,395,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	117,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	11,402		250 SF / MGD
Land Required - Odor Control (SF)	28,588		500 SF / 10,000 CFM
Land Required - Screening (SF)	11,402		250 SF / MGD
Land Required - Regulator (SF)	470,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*639,000*		
Land Required Cost (/ SF)	$ 2		Ref: Technical Parameters
Land Acquisition Cost $	**1,278,000**		
SUBTOTAL CAPITAL COST		**$**	**251,747,556**

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	94	
Peak Volume	7,815,477	CF
	58.46	MG
Total Volume	160,543,669	CF
	1200.87	MG
Peak Rate	1,217.19	CFS
	786.64	MGD

CONSOLIDATION SEWERS - Total			
94 Overflows / Year			
SUBTOTAL CAPITAL COST	**$**		**-**

TUNNEL STORAGE (AS-1 Outfalls plus A-38 thru A-41)			
94 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	58.46	7,815,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	73.07	9,769,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	19.75		Input by Engineer
Tunnel Volume / Ft length (CF)	306.20		Ref: Tunnel diameter
Tunnel Length (Ft)	31,904		= Req'd Fac Vol / Vol per Ft Length; Target length is 31,750 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	16	16	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MDG)	34	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**172,738,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	58.46	90.46	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	53		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	5.9	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	150		Input by Engineer
Construction Cost (PS / Force Main) $	**15,100,000**	**$ 95,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	76.07		Peak Flow / # drop shaft
Diameter (In)	66		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	3,750		75' per drop shaft
Average Depth (Ft)	20		Input by Engineer
Construction Cost (Consolidation Pipe) $	**4,698,000**	**$ -**	Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	14,654,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	732,700		= ACH x Volume / 60
Construction Cost (Odor Control) $	**16,100,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	58.46		Ref: CSO Statistics
Construction Cost (Screening) $	**3,119,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	58.46		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	29.23		= Peak Vol/DW Time
Construction Cost $	**22,260,643**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	50		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**64,250,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	125,000		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	14,615		250 SF / MGD
Land Required - Odor Control (SF)	36,635		500 SF / 10,000 CFM
Land Required - Screening (SF)	14,615		250 SF / MGD
Land Required - Regulator (SF)	500,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*691,000*		
Land Required Cost (/ SF) $	2		Ref: Technical Parameters
Land Acquisition Cost $	**1,382,000**		
SUBTOTAL CAPITAL COST	**$**		**304,440,643**

RESULTS SUMMARY			
Number of Events / Year	4		
Number of Overflows / Year	93		
Peak Volume	11,269,724	CF	
	84.30	MG	
Total Volume	253,663,404	CF	
	1897.40	MG	
Peak Rate	1,740.31	CFS	
	1124.71	MGD	

CONSOLIDATION SEWERS - Total			
93 Overflows / Year			
SUBTOTAL CAPITAL COST	**$**		**-**

TUNNEL STORAGE (AS-1 Outfalls plus A-38 thru A-41 and A-42)			
93 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	84.30	11,270,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	105.37	14,088,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	22.75		Input by Engineer
Tunnel Volume / Ft length (CF)	406.29		Ref: Tunnel diameter
Tunnel Length (Ft)	34,675		= Req'd Fac Vol / Vol per Ft Length; Target length is 34,750 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	17	17	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MDG)	34	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**237,211,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	84.30	130.44	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	63		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	6.0	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	150		Input by Engineer
Construction Cost (PS / Force Main) $	**21,811,000**	**$ 113,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	102.37		Peak Flow / # drop shaft
Diameter (In)	78		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	3,825		75' per drop shaft
Average Depth (Ft)	20		Input by Engineer
Construction Cost (Consolidation Pipe) $	**6,103,000**	**$ -**	Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	21,132,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	1,056,600		= ACH x Volume / 60
Construction Cost (Odor Control) $	**21,450,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	84.30		Ref: CSO Statistics
Construction Cost (Screening) $	**4,315,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	84.30		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	42.15		= Peak Vol/DW Time
Construction Cost $	**28,609,878**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	51		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**65,535,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	127,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	21,074		250 SF / MGD
Land Required - Odor Control (SF)	52,830		500 SF / 10,000 CFM
Land Required - Screening (SF)	21,074		250 SF / MGD
Land Required - Regulator (SF)	510,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*732,000*		
Land Required Cost (/ SF) $	2		Ref: Technical Parameters
Land Acquisition Cost $	**1,464,000**		
SUBTOTAL CAPITAL COST	**$**		**392,714,878**

Operation and Maintenance Costs

System Wide Alternative AS-1 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (A-01 thru A-37)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	45.61	$241,271	20	10.910	$2,632,254
	Tunnel Maintenance	Length (ft)	26900	$8,608	50	14.484	$124,674
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	47	$291,776	50	14.484	$4,225,957
	Screening O&M	Flow Rate (MGD)	45.61	$11,596	20	10.910	$126,512
	Odor Control O&M	Capacity (CFM)	571,750	$2,001,125	20	10.910	$21,832,152
	Reserve / Replace	10% Gravity / 15% Pump					$90,931
			Subtotal Annual O&M	**$2,555,000**		**Subtotal PW O&M**	**$29,033,000**

Subsystem Components

Heth's Run (A-38 thru A-41) Annual O&M	$ 505,000
Negley Run (A-42/42A) Annual O&M	$1,499,000
TOTAL ANNUAL O&M	**$4,559,000**
ANNUAL O&M ($MM)	**$4.56**

Operation and Maintenance Costs

System Wide Alternative AS-2 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (AS-1 Outfalls plus A-38 thru A-41)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	58.46	$284,791	20	10.910	$3,107,049
	Tunnel Maintenance	Length (ft)	31904	$10,209	50	14.484	$147,867
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	50	$300,825	50	14.484	$4,357,027
	Screening O&M	Flow Rate (MGD)	58.46	$12,905	20	10.910	$140,796
	Odor Control O&M	Capacity (CFM)	732,700	$2,564,450	20	10.910	$27,977,994
	Reserve / Replace	10% Gravity / 15% Pump					$113,884
			Subtotal Annual O&M	**$3,174,000**		**Subtotal PW O&M**	**$35,845,000**

Subsystem Components	
Negley Run (A-42/42A) Annual O&M	$1,499,000
TOTAL ANNUAL O&M	**$4,673,000**
ANNUAL O&M ($MM)	**$4.67**

System Wide Alternative AS-3 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (AS-1 Outfalls plus A-38 thru A-41 and A-42)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	84.30	$363,685	20	10.910	$3,967,782
	Tunnel Maintenance	Length (ft)	34675	$11,096	50	14.484	$160,710
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	51	$303,842	50	14.484	$4,400,716
	Screening O&M	Flow Rate (MGD)	84.30	$15,720	20	10.910	$171,507
	Odor Control O&M	Capacity (CFM)	1,056,600	$3,698,100	20	10.910	$40,346,046
	Reserve / Replace	10% Gravity / 15% Pump					$159,070
			Subtotal Annual O&M	**$4,393,000**		**Subtotal PW O&M**	**$49,206,000**

TOTAL ANNUAL O&M	**$4,393,000**
ANNUAL O&M ($MM)	**$4.39**

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AS-1	**Results Summary**	
Structures within Region	A-01 - A-42	Number of Events:	92
Model ID	AS-1.1	Peak Volume:	21,850,762 ft^3
Structure Type			163.45 MG
PWSA Sewershed		Total Volume:	129,983,762 ft^3
Stream of Discharge			972.34 MG
NPDES Permit Number		Peak Rate:	1615.08 cfs
Owner			

Model Network (07/19/07) Baseline Conditions#2 - FINAL!#1_1#2

Model Run 2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/5/2005 0:38	2875	1/5/2005 14:55	21850762.29	163454.627	0	479.67	11
1/11/2005 7:45	1807	1/12/2005 1:30	7115007.04	53223.810	1	440.93	13
5/13/2005 22:30	2385	5/13/2005 23:00	6682553.55	49988.842	2	907.51	6
10/24/2005 11:15	2336	10/25/2005 4:00	6576141.42	49192.826	3	185.00	35
2/14/2005 4:31	2457	2/14/2005 10:00	6097571.21	45612.881	4	165.60	38
11/29/2005 1:55	1407	11/29/2005 7:30	6051487.67	45268.154	5	459.85	12
1/3/2005 8:25	1622	1/3/2005 14:00	4716986.67	35285.419	6	233.82	28
3/28/2005 8:54	1614	3/28/2005 19:00	4640883.93	34716.132	7	335.88	20
11/14/2005 21:36	906	11/15/2005 4:00	4341727.85	32478.295	8	418.20	16
4/1/2005 19:10	2718	4/2/2005 6:30	4041188.50	30230.111	9	353.76	18
8/20/2005 18:15	310	8/20/2005 19:00	3806203.96	28472.309	10	1499.83	1
7/5/2005 16:15	338	7/5/2005 17:00	3712376.20	27770.430	11	1253.78	3
4/22/2005 15:45	1599	4/23/2005 4:20	3308550.22	24749.610	12	1039.56	4
7/15/2005 15:55	295	7/15/2005 17:45	2966261.79	22189.121	13	1461.27	2
1/13/2005 22:39	890	1/14/2005 2:15	2922632.03	21862.749	14	246.46	27
10/21/2005 18:51	1728	10/22/2005 16:45	2611462.44	19535.045	15	227.42	30
9/29/2005 5:11	298	9/29/2005 5:45	2577038.86	19277.539	16	1615.08	0
5/11/2005 22:30	229	5/11/2005 22:55	2264033.27	16936.101	17	862.70	7
3/23/2005 2:20	1274	3/23/2005 12:45	2098755.78	15699.743	18	232.90	29
1/8/2005 1:50	1024	1/8/2005 5:30	2070240.59	15486.435	19	323.59	21
7/26/2005 19:35	509	7/26/2005 20:10	2044539.57	15294.178	20	948.33	5
5/28/2005 8:25	885	5/28/2005 9:30	1923902.58	14391.753	21	346.86	19
12/15/2005 8:55	1648	12/15/2005 14:05	1888284.07	14125.309	22	182.67	36
2/20/2005 15:02	1884	2/20/2005 20:15	1862772.53	13934.470	23	319.78	22
8/8/2005 8:37	292	8/8/2005 9:40	1600329.71	11971.266	24	426.80	15
2/9/2005 14:26	611	2/9/2005 16:45	1500266.32	11222.742	25	274.56	25
7/16/2005 9:15	459	7/16/2005 9:30	1367396.00	10228.806	26	432.50	14
10/7/2005 7:38	633	10/7/2005 11:00	1320789.76	9880.168	27	306.86	23
11/16/2005 4:05	686	11/16/2005 4:35	1225310.81	9165.938	28	223.58	31
8/29/2005 9:45	474	8/29/2005 13:45	1155107.17	8640.779	29	409.02	17
6/11/2005 15:35	307	6/11/2005 18:00	1060353.85	7931.977	30	768.22	8
11/9/2005 19:20	175	11/9/2005 19:55	967703.60	7238.907	31	486.38	10
11/1/2005 14:46	352	11/1/2005 16:35	835199.47	6247.710	32	146.15	40

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
9/26/2005 5:37	717	9/26/2005 6:00	812989.73	6081.570	33	107.62	46
4/20/2005 18:40	409	4/20/2005 19:50	799573.52	5981.210	34	138.30	41
7/25/2005 13:15	365	7/25/2005 13:30	779033.18	5827.558	35	611.83	9
2/16/2005 6:54	465	2/16/2005 7:45	702084.47	5251.943	36	118.84	43
6/3/2005 7:05	650	6/3/2005 9:30	524356.14	3922.446	37	189.86	34
8/27/2005 15:16	157	8/27/2005 16:00	520191.08	3891.289	38	273.61	26
12/25/2005 11:00	413	12/25/2005 13:35	509950.00	3814.681	39	87.58	48
5/23/2005 12:15	508	5/23/2005 14:30	509004.98	3807.612	40	118.08	44
3/27/2005 16:35	341	3/27/2005 17:30	501549.96	3751.844	41	101.64	47
11/9/2005 4:15	138	11/9/2005 4:30	492064.27	3680.887	42	219.55	32
8/13/2005 20:00	85	8/13/2005 20:30	466037.06	3486.190	43	283.59	24
6/14/2005 18:52	167	6/14/2005 19:30	434289.04	3248.699	44	217.85	33
6/10/2005 19:41	88	6/10/2005 20:20	372618.98	2787.376	45	169.75	37
1/30/2005 11:37	274	1/30/2005 13:15	305799.10	2287.530	46	128.01	42
7/18/2005 7:50	80	7/18/2005 8:05	289231.71	2163.598	47	156.79	39
1/26/2005 4:50	369	1/26/2005 5:45	271073.41	2027.765	48	60.97	51
7/17/2005 16:30	188	7/17/2005 16:50	232320.41	1737.873	49	51.23	54
5/20/2005 3:06	552	5/20/2005 6:45	222127.40	1661.624	50	27.16	58
4/30/2005 4:35	547	4/30/2005 6:05	191244.25	1430.603	51	64.12	50
4/26/2005 20:35	361	4/27/2005 1:10	172886.13	1293.275	52	56.84	53
8/26/2005 21:00	119	8/26/2005 21:25	151476.17	1133.118	53	59.51	52
10/21/2005 7:20	168	10/21/2005 8:00	133247.20	996.756	54	37.35	55
11/24/2005 5:25	470	11/24/2005 9:55	111648.96	835.190	55	27.80	57
6/6/2005 9:20	85	6/6/2005 9:30	111015.29	830.450	56	111.53	45
3/7/2005 22:25	687	3/8/2005 1:50	106335.95	795.446	57	14.59	68
6/16/2005 11:07	162	6/16/2005 11:45	103188.64	771.903	58	32.75	56
12/26/2005 5:25	570	12/26/2005 11:35	100645.58	752.879	59	11.15	72
9/23/2005 2:40	65	9/23/2005 3:00	84823.02	634.519	60	69.11	49
3/12/2005 10:53	268	3/12/2005 12:20	84358.51	631.044	61	15.09	66
3/20/2005 3:55	866	3/20/2005 8:05	83488.37	624.535	62	21.31	63
5/27/2005 18:20	210	5/27/2005 21:15	70762.80	529.341	63	24.37	60
6/28/2005 18:10	110	6/28/2005 19:30	66810.20	499.774	64	18.09	64
12/9/2005 3:52	87	12/9/2005 4:30	58503.61	437.636	65	26.33	59
11/8/2005 14:45	90	11/8/2005 15:35	53716.75	401.828	66	22.19	62
5/7/2005 12:45	158	5/7/2005 14:00	50866.76	380.509	67	23.05	61
8/16/2005 6:25	212	8/16/2005 8:30	45659.45	341.556	68	16.03	65
11/6/2005 9:50	300	11/6/2005 10:35	38452.98	287.647	69	13.44	69
6/17/2005 1:10	82	6/17/2005 2:00	35394.58	264.769	70	13.15	70
4/24/2005 3:15	934	4/24/2005 17:30	19069.94	142.653	71	1.14	85
5/21/2005 15:15	40	5/21/2005 15:30	18828.48	140.846	72	14.85	67
3/11/2005 8:21	382	3/11/2005 8:45	17725.42	132.595	73	11.35	71
10/26/2005 8:55	143	10/26/2005 10:45	16719.49	125.070	74	8.26	74
10/24/2005 3:15	59	10/24/2005 3:35	16309.74	122.005	75	7.71	75
2/8/2005 6:00	104	2/8/2005 6:15	16183.61	121.061	76	9.42	73
11/23/2005 20:01	149	11/23/2005 20:35	15617.27	116.825	77	6.07	78
8/5/2005 10:51	78	8/5/2005 11:30	13814.38	103.338	78	7.22	77
2/26/2005 13:02	227	2/26/2005 15:15	13414.56	100.348	79	3.94	81
3/24/2005 9:28	241	3/24/2005 9:55	8485.73	63.478	80	1.06	86
7/18/2005 19:05	30	7/18/2005 19:15	6935.04	51.878	81	7.62	76
6/21/2005 12:55	53	6/21/2005 13:35	4991.61	37.340	82	5.77	79
11/14/2005 0:10	49	11/14/2005 0:45	3917.62	29.306	83	5.63	80
2/25/2005 13:15	100	2/25/2005 13:25	2255.74	16.874	84	2.20	83
7/21/2005 14:25	30	7/21/2005 14:45	1850.80	13.845	85	1.89	84
4/25/2005 8:06	118	4/25/2005 8:55	1751.36	13.101	86	0.45	88

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
7/12/2005 20:13	87	7/12/2005 21:10	1332.13	9.965	87	0.52	87
5/19/2005 20:15	15	5/19/2005 20:20	1021.43	7.641	88	2.43	82
2/10/2005 8:29	91	2/10/2005 9:00	555.89	4.158	89	0.16	90
1/17/2005 9:12	92	1/17/2005 10:05	252.42	1.888	90	0.06	91
6/6/2005 17:20	11	6/6/2005 17:25	89.34	0.668	91	0.26	89

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AS-1
Structures within Region	A-01 - A-42
Model ID	AS-1.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	92	
Peak Volume:	21,850,762	ft^3
	163.45	MG
Total Volume:	129,983,762	ft^3
	972.34	MG
Peak Rate:	1615.08	cfs

Figure 1 - AS-1 Region CSO Volume

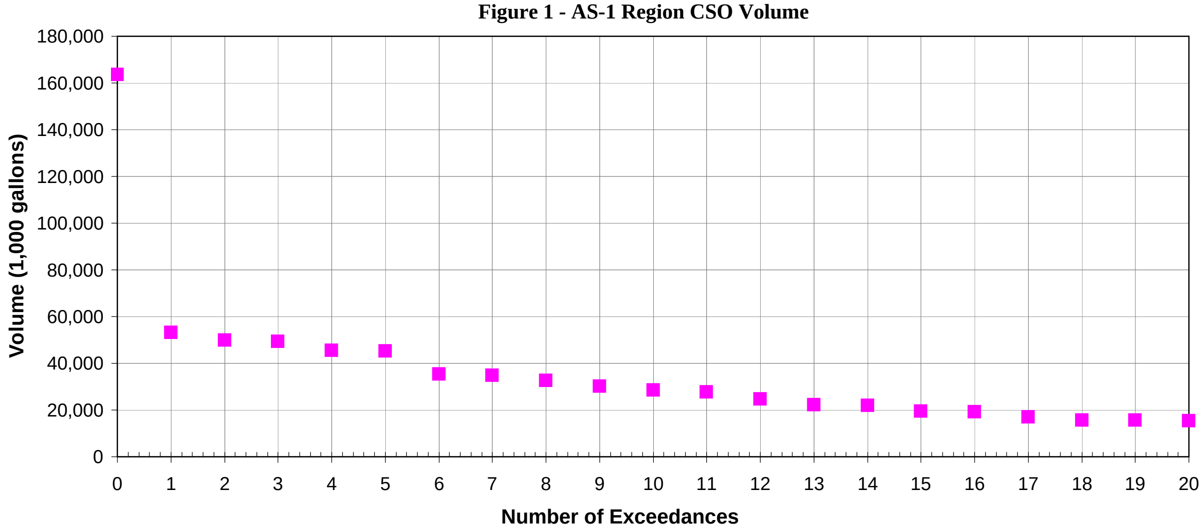
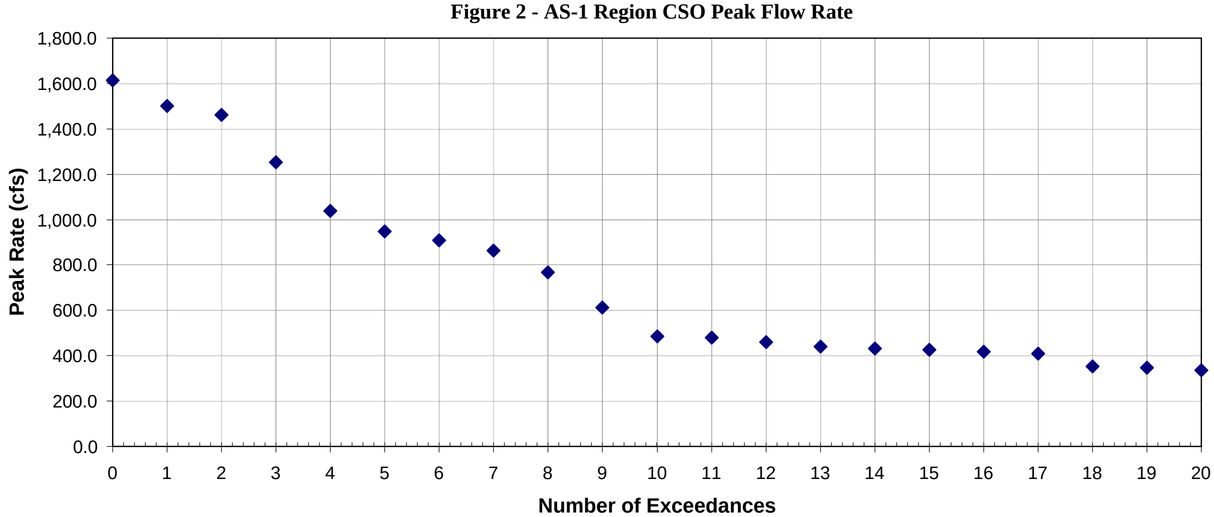


Figure 2 - AS-1 Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AS-2
Structures within Region	A-01 - A-41
Model ID	AS-2.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	94	
Peak Volume:	30,803,767	ft^3
	230.43	MG
Total Volume:	160,543,669	ft^3
	1200.95	MG
Peak Rate:	1842.64	cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/5/2005 0:38	5568	1/5/2005 14:55	30803766.96	230427.579	0	555.94	10
1/11/2005 7:45	1866	1/12/2005 1:30	9383444.64	70192.858	1	512.48	13
2/14/2005 4:30	4071	2/14/2005 10:05	9181982.05	68685.817	2	196.30	37
5/13/2005 22:30	2429	5/13/2005 23:00	7892614.39	59040.702	3	1043.18	6
10/24/2005 11:15	2336	10/25/2005 4:00	7815476.94	58463.675	4	208.39	36
11/29/2005 1:55	1950	11/29/2005 7:30	7142600.47	53430.223	5	522.97	12
1/3/2005 8:25	2051	1/3/2005 14:00	6380058.95	47726.031	6	270.70	28
3/28/2005 8:54	2362	3/28/2005 19:00	6219990.21	46528.637	7	396.58	19
4/1/2005 19:10	3153	4/2/2005 6:30	5631090.21	42123.370	8	400.70	18
11/14/2005 21:36	906	11/15/2005 4:00	5041894.62	37715.893	9	502.41	14
8/20/2005 18:15	310	8/20/2005 19:00	4324240.11	32347.478	10	1578.30	1
7/5/2005 16:15	338	7/5/2005 17:00	4235246.00	31681.758	11	1368.53	3
4/22/2005 15:45	1599	4/23/2005 4:20	3923427.91	29349.202	12	1217.19	4
1/13/2005 22:40	1021	1/14/2005 2:15	3749286.69	28046.539	13	282.16	26
7/15/2005 15:55	295	7/15/2005 17:45	3185282.61	23827.507	14	1566.45	2
10/21/2005 18:51	1728	10/22/2005 16:45	3037592.45	22722.710	15	256.77	31
9/29/2005 5:11	298	9/29/2005 5:45	2915904.15	21812.421	16	1842.64	0
2/20/2005 15:02	1954	2/20/2005 20:15	2570040.46	19225.188	17	370.69	21
3/23/2005 2:20	1274	3/23/2005 12:45	2522289.89	18867.990	18	264.92	29
5/11/2005 22:30	229	5/11/2005 22:55	2489799.67	18624.946	19	898.13	7
7/26/2005 19:35	509	7/26/2005 20:05	2353905.03	17608.387	20	1058.21	5
12/15/2005 8:55	1648	12/15/2005 14:05	2333494.65	17455.707	21	214.26	35
5/28/2005 8:25	885	5/28/2005 9:30	2243105.11	16779.548	22	390.46	20
8/8/2005 8:37	292	8/8/2005 9:40	1810701.80	13544.955	23	445.78	15
2/9/2005 14:26	617	2/9/2005 16:50	1789598.26	13387.090	24	314.32	24
7/16/2005 9:15	488	7/16/2005 9:30	1565460.92	11710.430	25	432.51	16
10/7/2005 7:37	632	10/7/2005 11:00	1546742.87	11570.410	26	349.15	23
11/16/2005 4:05	686	11/16/2005 4:35	1504378.26	11253.502	27	261.49	30
8/29/2005 9:45	474	8/29/2005 13:45	1253849.17	9379.419	28	413.28	17
4/20/2005 18:40	409	4/20/2005 19:50	1119761.33	8376.375	29	160.86	40
6/11/2005 15:35	307	6/11/2005 18:00	1086456.31	8127.236	30	768.22	8
11/9/2005 19:20	175	11/9/2005 19:50	1076167.88	8050.274	31	534.98	11
9/26/2005 5:37	717	9/26/2005 6:00	995151.49	7444.231	32	134.93	42

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
11/1/2005 14:46	352	11/1/2005 16:35	964598.15	7215.676	33	170.18	38
7/25/2005 13:15	365	7/25/2005 13:30	781784.21	5848.137	34	611.83	9
8/13/2005 20:00	85	8/13/2005 20:15	692305.17	5178.789	35	354.44	22
5/23/2005 12:15	508	5/23/2005 14:30	651307.72	4872.107	36	163.61	39
12/25/2005 11:00	413	12/25/2005 13:45	629030.28	4705.461	37	102.34	46
6/3/2005 7:05	650	6/3/2005 9:30	610938.45	4570.125	38	217.79	34
8/27/2005 15:16	157	8/27/2005 16:00	602365.57	4505.996	39	304.05	25
6/10/2005 19:41	97	6/10/2005 20:20	591950.96	4428.089	40	276.22	27
3/27/2005 16:35	354	3/27/2005 17:30	588793.70	4404.471	41	115.85	44
11/9/2005 4:15	138	11/9/2005 4:45	566629.90	4238.675	42	228.47	32
6/14/2005 18:52	167	6/14/2005 19:30	452970.04	3388.442	43	217.85	33
1/30/2005 11:37	274	1/30/2005 13:15	355367.42	2658.326	44	133.05	43
1/26/2005 4:50	381	1/26/2005 5:45	344931.28	2580.258	45	60.97	50
7/18/2005 7:50	80	7/18/2005 8:05	322699.59	2413.954	46	156.79	41
7/17/2005 16:30	188	7/17/2005 17:35	247000.04	1847.684	47	56.09	54
4/30/2005 4:35	572	4/30/2005 6:05	246183.99	1841.579	48	72.31	47
5/20/2005 3:06	552	5/20/2005 6:45	239033.17	1788.088	49	27.16	59
4/26/2005 20:35	361	4/27/2005 1:10	216123.14	1616.709	50	71.90	48
6/6/2005 9:20	85	6/6/2005 9:35	177964.94	1331.267	51	112.02	45
12/26/2005 5:25	570	12/26/2005 11:40	166852.20	1248.138	52	16.54	67
8/26/2005 21:00	119	8/26/2005 21:25	165934.84	1241.276	53	59.51	52
3/7/2005 22:25	688	3/8/2005 1:55	147116.14	1100.502	54	18.80	64
3/20/2005 3:55	866	3/20/2005 8:00	143979.68	1077.040	55	26.97	60
11/24/2005 5:25	470	11/24/2005 9:55	141889.26	1061.403	56	35.16	56
10/21/2005 7:20	168	10/21/2005 8:00	141730.20	1060.213	57	37.35	55
6/28/2005 18:10	110	6/28/2005 18:20	132894.44	994.117	58	60.47	51
5/27/2005 18:20	210	5/27/2005 18:45	131074.96	980.506	59	57.24	53
6/16/2005 11:07	163	6/16/2005 11:45	108949.10	814.994	60	32.76	57
3/12/2005 10:53	279	3/12/2005 12:30	103136.29	771.511	61	17.06	65
9/23/2005 2:40	65	9/23/2005 3:00	85276.78	637.913	62	69.11	49
2/26/2005 11:15	407	2/26/2005 14:55	79257.11	592.883	63	15.64	69
12/9/2005 3:52	87	12/9/2005 4:30	58503.61	437.636	64	26.33	61
11/8/2005 14:45	90	11/8/2005 15:35	53716.75	401.828	65	22.19	63
5/7/2005 12:45	158	5/7/2005 14:05	52619.35	393.619	66	23.43	62
11/6/2005 9:50	300	11/6/2005 10:35	51754.40	387.149	67	14.65	70
8/16/2005 6:25	212	8/16/2005 8:30	46887.65	350.743	68	16.50	68
4/24/2005 3:15	934	4/24/2005 17:45	45622.57	341.280	69	4.40	80
6/17/2005 1:10	82	6/17/2005 2:00	36869.90	275.805	70	14.01	71
3/11/2005 8:21	408	3/11/2005 8:45	24063.02	180.003	71	11.34	72
2/8/2005 6:00	144	2/8/2005 6:15	21634.94	161.840	72	9.42	73
5/21/2005 15:15	40	5/21/2005 15:30	21606.88	161.630	73	16.69	66
6/21/2005 12:55	53	6/21/2005 13:10	21591.15	161.513	74	27.77	58
10/24/2005 3:15	59	10/24/2005 3:35	19910.47	148.940	75	9.26	74
3/24/2005 8:20	310	3/24/2005 9:55	18424.18	137.822	76	1.85	87
11/23/2005 20:01	158	11/23/2005 20:35	17380.96	130.018	77	6.07	78
10/26/2005 8:55	143	10/26/2005 10:45	16718.36	125.062	78	8.26	75
2/10/2005 7:25	297	2/10/2005 8:55	14366.67	107.470	79	1.32	88
8/5/2005 10:51	78	8/5/2005 11:30	13813.97	103.335	80	7.22	77
4/25/2005 1:55	515	4/25/2005 8:50	11243.05	84.104	81	2.12	83
3/30/2005 7:43	268	3/30/2005 8:20	10768.57	80.554	82	1.04	89
2/17/2005 7:35	281	2/17/2005 8:45	10393.36	77.747	83	0.95	90
7/18/2005 19:05	30	7/18/2005 19:15	6935.19	51.879	84	7.62	76
11/14/2005 0:10	49	11/14/2005 0:45	3917.62	29.306	85	5.63	79
2/25/2005 13:15	470	2/25/2005 13:25	3716.54	27.802	86	2.20	82

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	**Exceedance Duration (minutes)**	**Time of Peak Flow**	**(ft^3)**	**(1,000 gallons)**	**Number of Exceedances**	**(cfs)**	**Number of Exceedances**
7/21/2005 14:25	30	7/21/2005 14:45	1850.80	13.845	87	1.89	86
7/12/2005 20:13	87	7/12/2005 21:10	1331.87	9.963	88	0.52	91
5/19/2005 20:15	15	5/19/2005 20:20	1021.43	7.641	89	2.43	81
3/4/2005 13:25	15	3/4/2005 13:30	835.12	6.247	90	1.96	85
9/17/2005 8:45	14	9/17/2005 8:50	713.23	5.335	91	2.04	84
2/27/2005 12:32	52	2/27/2005 12:55	496.65	3.715	92	0.29	92
6/6/2005 17:20	11	6/6/2005 17:25	89.34	0.668	93	0.26	93

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AS-2
Structures within Region	A-01 - A-41
Model ID	AS-2.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	94	
Peak Volume:	30,803,767	ft^3
	230.43	MG
Total Volume:	160,543,669	ft^3
	1200.95	MG
Peak Rate:	1842.64	cfs

Figure 1 - AS-2 Region CSO Volume

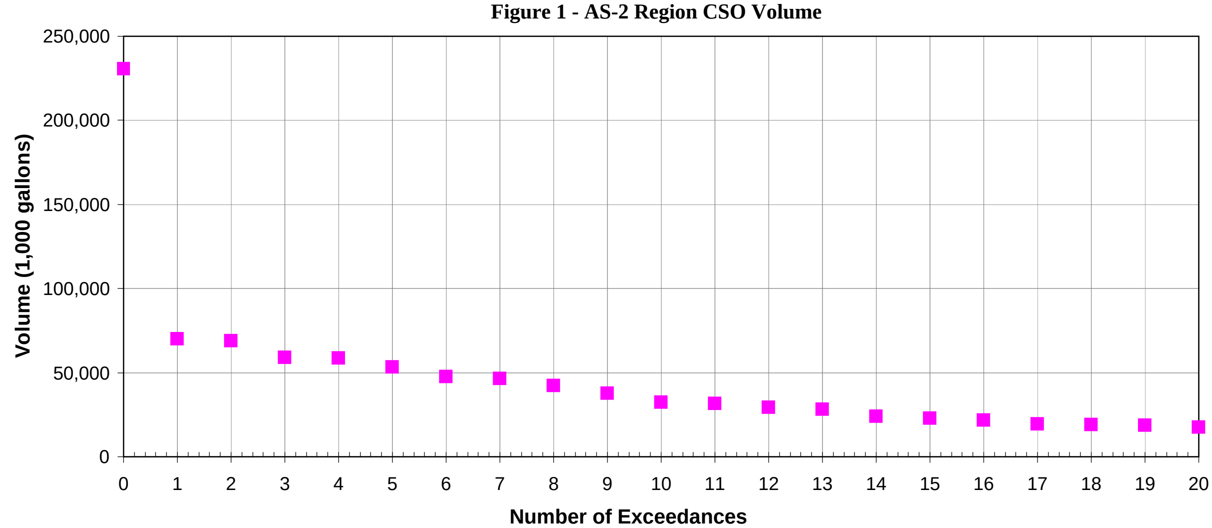
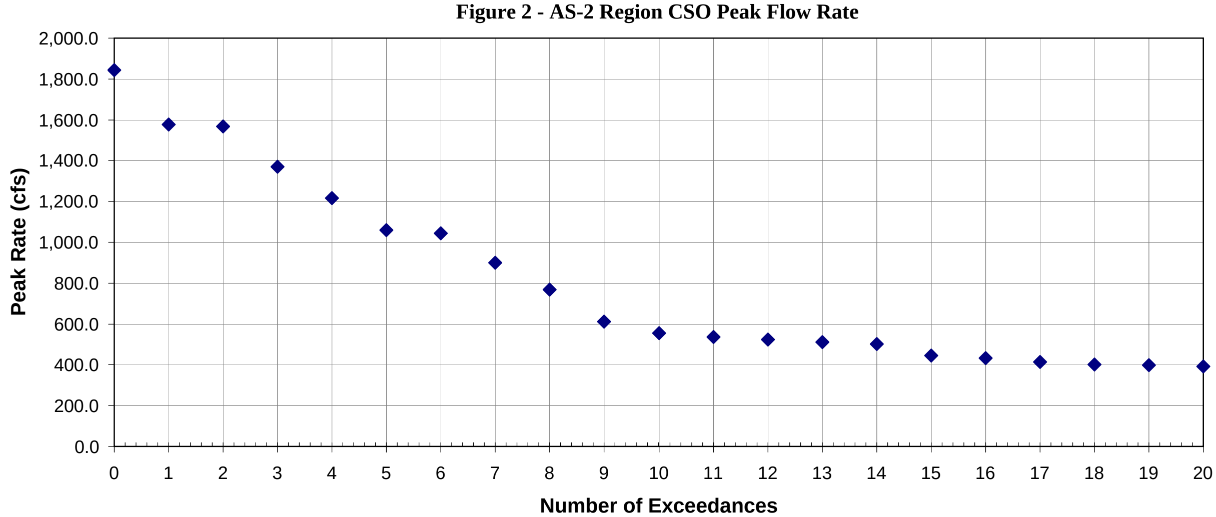


Figure 2 - AS-2 Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AS-3
Structures within Region	A-01 - A-37
Model ID	AS-3.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	93	
Peak Volume:	66,815,375	ft^3
	499.81	MG
Total Volume:	253,663,404	ft^3
	1897.53	MG
Peak Rate:	2402.90	cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/3/2005 8:23	8079	1/5/2005 14:55	66815374.73	499812.411	0	851.97	11
1/11/2005 7:45	2097	1/12/2005 1:35	16862226.80	126137.888	1	762.05	12
2/14/2005 4:30	4071	2/14/2005 10:05	14601750.67	109228.396	2	289.66	35
11/29/2005 1:55	1950	11/29/2005 7:30	11270614.36	84309.831	3	727.23	13
5/13/2005 22:30	2429	5/13/2005 23:05	11269724.46	84303.174	4	1788.44	3
10/24/2005 2:55	2836	10/25/2005 4:00	11100505.03	83037.328	5	291.69	34
3/28/2005 8:54	2362	3/28/2005 19:05	9806541.87	73357.836	6	542.01	20
4/1/2005 19:10	3153	4/2/2005 6:30	9007547.66	67380.960	7	544.25	19
11/14/2005 21:36	906	11/15/2005 4:05	6974809.13	52175.060	8	664.11	14
1/13/2005 22:41	1215	1/14/2005 2:35	6827029.80	51069.596	9	427.01	29
8/20/2005 18:15	310	8/20/2005 18:55	6770956.32	50650.139	10	2402.90	0
4/22/2005 15:45	1599	4/23/2005 4:20	5740672.42	42943.100	11	1889.77	2
7/5/2005 16:15	338	7/5/2005 16:55	5609319.56	41960.515	12	1740.31	4
10/21/2005 18:51	1758	10/22/2005 7:10	4562427.27	34129.237	13	498.41	22
2/20/2005 15:02	1954	2/20/2005 20:15	4072382.77	30463.459	14	554.45	17
9/29/2005 5:11	298	9/29/2005 5:45	3902302.45	29191.174	15	2194.80	1
3/23/2005 2:20	1274	3/23/2005 12:50	3681804.07	27541.735	16	366.31	31
7/26/2005 19:35	509	7/26/2005 20:05	3573516.92	26731.693	17	1593.04	6
12/15/2005 8:55	1648	12/15/2005 14:15	3536273.40	26453.093	18	312.66	32
8/8/2005 8:37	292	8/8/2005 9:40	3450698.98	25812.954	19	924.35	9
7/15/2005 15:55	295	7/15/2005 17:45	3328656.12	24900.012	20	1608.60	5
5/28/2005 8:25	885	5/28/2005 9:30	3273014.14	24483.782	21	529.22	21
5/11/2005 22:30	229	5/11/2005 22:55	3250438.08	24314.902	22	1016.50	8
7/16/2005 9:15	488	7/16/2005 12:10	2720937.64	20353.974	23	475.19	25
2/9/2005 14:26	617	2/9/2005 17:00	2652858.45	19844.708	24	456.81	26
11/16/2005 4:05	686	11/16/2005 4:35	2351633.87	17591.397	25	436.41	28
10/7/2005 7:37	638	10/7/2005 11:00	2201194.64	16466.036	26	483.08	23
11/9/2005 19:20	175	11/9/2005 19:50	1780824.70	13321.459	27	1081.03	7
4/20/2005 18:40	409	4/20/2005 19:10	1731362.31	12951.456	28	257.13	36
9/26/2005 5:37	717	9/26/2005 6:05	1589550.47	11890.632	29	193.82	40
8/29/2005 9:45	474	8/29/2005 13:45	1521329.73	11380.307	30	423.15	30
11/1/2005 14:46	352	11/1/2005 16:35	1342382.27	10041.691	31	243.07	37
6/11/2005 15:35	307	6/11/2005 18:00	1252304.95	9367.867	32	869.16	10

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
8/13/2005 20:00	85	8/13/2005 20:20	1122187.71	8394.525	33	628.79	15
5/23/2005 12:10	512	5/23/2005 14:50	1114102.14	8334.041	34	228.45	39
6/10/2005 19:41	172	6/10/2005 20:20	1106382.25	8276.292	35	477.63	24
8/27/2005 15:16	157	8/27/2005 15:55	990170.90	7406.973	36	552.59	18
6/3/2005 6:50	665	6/3/2005 9:35	965897.07	7225.393	37	295.90	33
12/25/2005 11:00	413	12/25/2005 13:15	920194.38	6883.514	38	146.22	44
6/14/2005 18:52	167	6/14/2005 19:30	861030.70	6440.940	39	446.65	27
3/27/2005 16:35	354	3/27/2005 17:30	827897.54	6193.088	40	161.04	42
7/25/2005 13:15	365	7/25/2005 13:30	806292.51	6031.471	41	611.83	16
11/9/2005 4:15	138	11/9/2005 4:45	667300.36	4991.740	42	236.98	38
1/26/2005 4:50	381	1/26/2005 5:45	494559.00	3699.549	43	62.01	54
1/30/2005 11:05	306	1/30/2005 13:15	453781.09	3394.509	44	151.55	43
7/18/2005 7:50	90	7/18/2005 8:20	385848.53	2886.340	45	161.64	41
7/17/2005 16:30	188	7/17/2005 17:40	327681.84	2451.224	46	79.75	49
4/30/2005 4:35	572	4/30/2005 6:05	325518.99	2435.045	47	106.23	46
4/26/2005 20:35	361	4/27/2005 1:15	319644.43	2391.100	48	97.47	47
12/26/2005 5:25	571	12/26/2005 11:40	283596.94	2121.447	49	27.47	65
5/20/2005 3:06	552	5/20/2005 6:50	258192.05	1931.406	50	31.00	63
11/24/2005 5:25	470	11/24/2005 9:55	254064.75	1900.531	51	67.42	51
3/7/2005 22:25	688	3/8/2005 1:55	235907.48	1764.706	52	25.65	68
10/21/2005 7:20	168	10/21/2005 8:00	225594.28	1687.558	53	55.86	55
3/20/2005 3:55	866	3/20/2005 7:55	218830.38	1636.961	54	46.45	57
6/28/2005 18:10	110	6/28/2005 18:25	211921.88	1585.282	55	90.19	48
8/26/2005 21:00	119	8/26/2005 21:45	197532.70	1477.643	56	62.38	53
6/6/2005 9:20	85	6/6/2005 9:35	196655.16	1471.079	57	112.02	45
5/27/2005 18:20	210	5/27/2005 18:45	158400.06	1184.912	58	63.40	52
2/26/2005 11:15	407	2/26/2005 15:25	135661.83	1014.818	59	28.35	64
3/12/2005 10:53	279	3/12/2005 12:30	120041.89	897.973	60	27.42	66
6/16/2005 11:07	163	6/16/2005 11:45	117586.67	879.607	61	33.45	62
8/16/2005 6:25	212	8/16/2005 8:25	112098.53	838.553	62	39.03	58
11/6/2005 9:50	300	11/6/2005 10:25	96066.47	718.625	63	37.36	60
9/23/2005 2:40	65	9/23/2005 3:00	85276.78	637.913	64	69.11	50
4/24/2005 3:15	1875	4/24/2005 17:00	83396.88	623.850	65	9.57	73
5/7/2005 12:45	158	5/7/2005 14:05	72402.02	541.603	66	38.56	59
6/17/2005 0:50	139	6/17/2005 2:00	62233.20	465.535	67	22.04	70
5/21/2005 15:05	75	5/21/2005 15:30	59267.46	443.350	68	35.92	61
12/9/2005 3:52	87	12/9/2005 4:30	58503.61	437.636	69	26.33	67
11/8/2005 14:45	90	11/8/2005 15:35	54099.91	404.694	70	22.19	69
6/21/2005 12:55	53	6/21/2005 13:10	43464.01	325.133	71	54.86	56
3/11/2005 8:21	412	3/11/2005 14:35	40294.39	301.422	72	14.01	71
2/8/2005 6:00	144	2/8/2005 6:15	26790.50	200.406	73	10.46	72
11/23/2005 20:01	173	11/23/2005 22:30	25811.23	193.081	74	7.89	75
3/24/2005 8:20	310	3/24/2005 9:55	18424.18	137.822	75	1.85	84
10/26/2005 8:55	143	10/26/2005 10:45	16718.36	125.062	76	8.26	74
2/10/2005 7:25	297	2/10/2005 8:55	14366.67	107.470	77	1.32	85
8/5/2005 10:51	78	8/5/2005 11:30	13813.97	103.335	78	7.22	77
3/30/2005 7:43	268	3/30/2005 8:20	10768.57	80.554	79	1.04	86
2/17/2005 7:35	281	2/17/2005 8:45	10393.36	77.747	80	0.95	87
7/18/2005 19:05	30	7/18/2005 19:15	6935.19	51.879	81	7.62	76
11/14/2005 0:10	49	11/14/2005 0:45	4755.87	35.576	82	5.63	78
2/25/2005 13:15	470	2/25/2005 13:25	3716.54	27.802	83	2.20	81
3/4/2005 12:57	42	3/4/2005 13:30	2502.38	18.719	84	3.56	79
7/21/2005 14:25	30	7/21/2005 14:45	1850.80	13.845	85	1.89	83
7/12/2005 20:13	87	7/12/2005 21:10	1331.87	9.963	86	0.52	88

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
5/19/2005 20:15	15	5/19/2005 20:20	1021.43	7.641	87	2.43	80
9/17/2005 8:45	14	9/17/2005 8:50	713.23	5.335	88	2.04	82
2/27/2005 12:32	52	2/27/2005 12:55	496.65	3.715	89	0.29	90
6/6/2005 17:20	29	6/6/2005 17:40	369.96	2.767	90	0.41	89
9/16/2005 9:25	8	9/16/2005 9:30	54.98	0.411	91	0.19	91
7/5/2005 4:01	7	7/5/2005 4:05	23.67	0.177	92	0.09	92

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	AS-3	**Results Summary**	
Structures within Region	A-01 - A-37	Number of Events:	93
Model ID	AS-3.1	Peak Volume:	66,815,375 ft^3
Structure Type			499.81 MG
PWSA Sewershed		Total Volume:	253,663,404 ft^3
Stream of Discharge			1897.53 MG
NPDES Permit Number		Peak Rate:	2402.90 cfs
Owner			

Model Network (07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run 2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Figure 1 - AS-3 Region CSO Volume

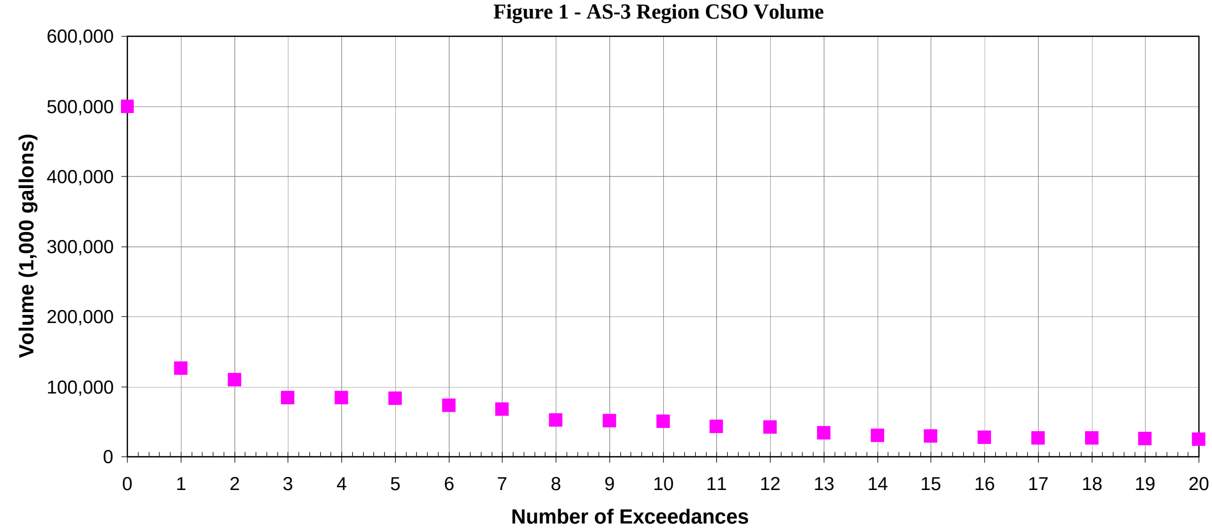
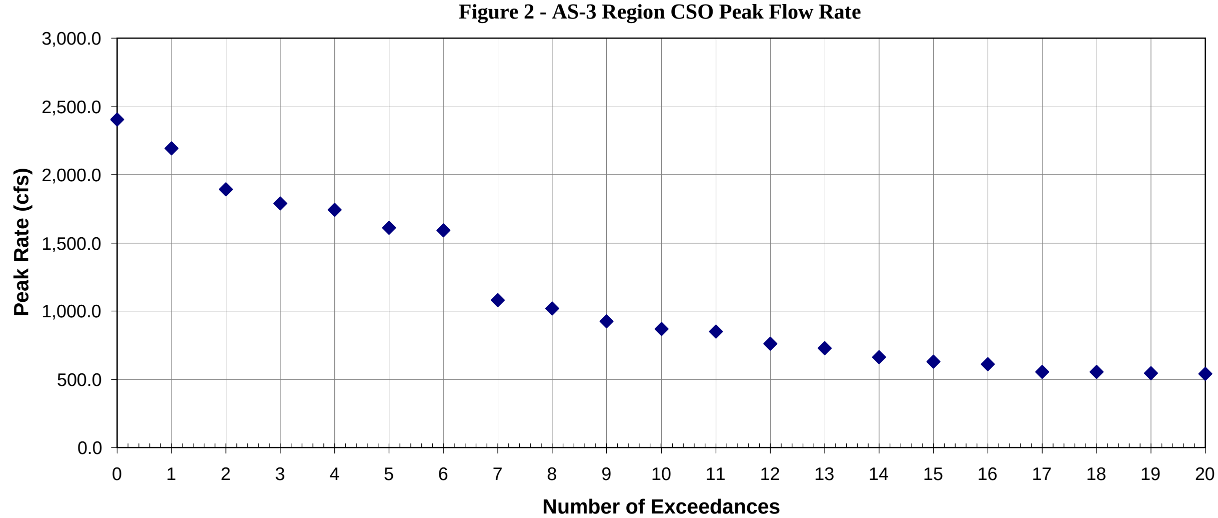


Figure 2 - AS-3 Region CSO Peak Flow Rate



F.2 ALLEGHENY SOUTH SUBSYSTEM

Description of Subsystem

The Allegheny – South (AS) Subsystem is located along the southern bank of the Allegheny River between A-01 and A-42. Control of CSOs within this Subsystem will be based upon Tunnel Storage, in combination with the highest ranked Regional CSO control technologies in the areas not served by the Tunnel. This combination serves to control CSO originating from the following Regions:

- Downtown Allegheny Region (A-01 to A-15)
- Strip District Region (A-16 to A-21)
- Two Mile Run Region (A-22 and A-23)
- Lawrenceville Region (A-25 to A-37)
- Heths Run Region (A-38 to A-41)
- Negley Run Region (A-42)

All of these Regions, and their associated outfalls, currently convey overflows from their respective diversion chambers directly to the Allegheny River.

The entire area that is encompassed in this alternative includes approximately 7,700 acres of residential, business and commercial users.

Description of Alternatives

In an effort to determine the most effective combination of controls for this Subsystem, three variations were developed and evaluated. They are labeled AS-1, AS-2, and AS-3. These subsystem variations were based upon a capture level of 4 CSO events per year. A brief description of each is given below.

Alternative AS-1

Alternative AS-1 is based upon Tunnel AS-1, having an approximate length of 27,000 feet. *Attachment 1 – Subsystem Alternative AS-1* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Allegheny South system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel AS-1 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 163.44 MG to 35.28 MG for control levels of 0 to 6 overflow events, respectively. *Figure 1 – AS-1 Region CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

Figure 1 - AS-1 Region CSO Volume

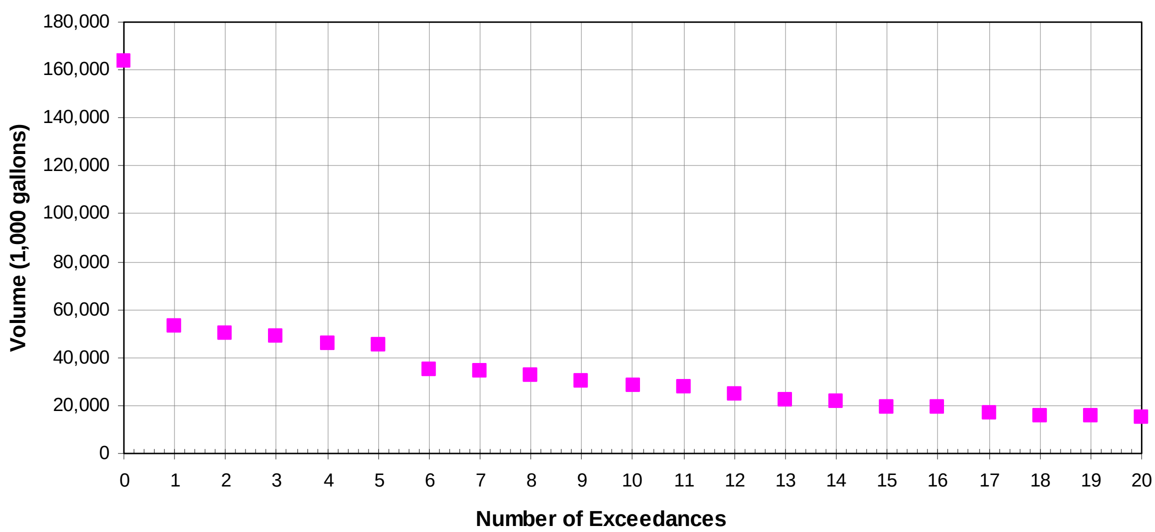


Table 1 - Alternative AS-1 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 1: Alternative AS-1 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Downtown Allegheny	A-1 thru A-15	270	92	Tunnel AS-1
Strip District	A-16 thru A-21	440		
Two Mile Run	A-22 and A-23	1,880		
Lawrenceville	A-25 thru A-37A	1,450		

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Heths Run	A-38, A-40 and A-41, DC121L001	780	84	Integrated Outfalls
Negley Run	A-42 / A-42A	2,885	78	Screening & Disinfection

<u>Tunnel AS-1</u>

The Allegheny South Tunnel AS-1 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers A-01 to A-37. A pump station will be constructed in the vicinity of A-01 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 163.5 MGD for 0 overflows to 35.5 MGD for 6 overflows. Assuming a tunnel length of approximately 5.1 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 19 feet.

Other important components of Tunnel AS-1 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel alignment to convey flow from overflow structures to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 2 - Tunnel AS-1 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates of the drop shafts at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts. No significant consolidation sewers are anticipated to be constructed in association with this tunnel segment. New drop shafts will be constructed adjacent to existing ALCOSAN regulating structures.

Table 2: Tunnel AS-1 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-1	Near A-01	A-01	6.78	N/A	N/A
AS-2	Near A-02	A-02	0.91	N/A	N/A
AS-3	Near A-03	A-03	1.35	N/A	N/A
AS-4	Near A-04	A-04	18.92	N/A	N/A
AS-5	Near A-05	A-05	3.36	N/A	N/A
AS-6	Near A-06	A-06	9.31	N/A	N/A
AS-7	Near A-07	A-07	5.83	N/A	N/A
AS-8	Near A-08	A-08	0.28	N/A	N/A
AS-9	Near A-09	A-09	21.24	N/A	N/A
AS-10	Near A-10	A-10	8.68	N/A	N/A
AS-11	Near A-11	A-11	4.86	N/A	N/A
AS-12	Near A-12	A-12	31.53	N/A	N/A
AS-13	Near A-13	A-13	9.84	N/A	N/A
AS-13A	Near A-13A	A-13A	9.36	N/A	N/A
AS-14	Near A-14	A-14	23.70	N/A	N/A
AS-14A	Near A-14A	A-14A	0.73	N/A	N/A
AS-15	Near A-15	A-15	13.52	N/A	N/A
AS-16	Near A-16	A-16	16.62	N/A	N/A
AS-17	Near A-17	A-17	19.85	N/A	N/A
AS-17A	Near A-17A	A-17A	2.49	N/A	N/A
AS-17B	Near A-17B	A-17B	2.10	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-18	Near A-18	A-18	34.83	N/A	N/A
AS-18A	Near A-18A	A-18A	10.07	N/A	N/A
AS-18B	Near A-18B	A-18B	3.70	N/A	N/A
AS-19	Near A-19	A-19	26.91	N/A	N/A
AS-19A	Near A-19A	A-19A	31.58	N/A	N/A
AS-19B	Near A-19B	A-19B	2.07	N/A	N/A
AS-20	Near A-20	A-20	43.06	N/A	N/A
AS-21	Near A-21	A-21	59.38	N/A	N/A
AS-22	Near A-22	A-22	766.30	N/A	N/A
AS-23	Near A-23	A-23	261.67	N/A	N/A
AS-25	Near A-25	A-25	38.99	N/A	N/A
AS-26	Near A-26	A-26	64.49	N/A	N/A
AS-27	Near A-27	A-27	36.59	N/A	N/A
AS-27A	Near A-27A	A-27A	16.82	N/A	N/A
AS-28	Near A-28	A-28	119.40	N/A	N/A
AS-29	Near A-29	A-29	75.06	N/A	N/A
AS-29A	Near A-29A	A-29A	106.54	N/A	N/A
AS-30	Near A-30	A-30	12.95	N/A	N/A
AS-31	Near A-31	A-31	16.86	N/A	N/A
AS-32	Near A-32	A-32	46.57	N/A	N/A
AS-33	Near A-33	A-33	41.02	N/A	N/A
AS-34	Near A-34	A-34	29.13	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-35	Near A-35	A-35	87.25	N/A	N/A
AS-36	Near A-36	A-36	19.87	N/A	N/A
AS-37	Near A-37	A-37	7.24	N/A	N/A
AS-37A	Near A-37A	A-37A	21.29	N/A	N/A

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the AS-1 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Allegheny River. Approximately 1 acre of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 2 - Subsystem Alternative AS-1, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>Heths Run Region</u> CSOs from this portion of Alternative AS-1 will be controlled via implementation of integrated outfall solutions. This means that each outfall will be controlled by the highest rated solution for each outfall.

- A-38: Sub-surface storage tank
- A-40: Sub-surface storage tank
- A-41: Surface storage tank

Flows from DC121H001 are accounted for in the evaluation of A-41.

Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities. Surface storage facilities require the same ancillary facilities except that they require and influent pumping station.

Negley Run Region CSOs from this portion of Alternative AS-1 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

Although Tunnel Storage was the highest rated CSO control alternative, it was decided that screening and disinfection would be a more viable option for two reasons. First, there is very little difference in the objective scoring between tunnel storage (.604) and screening and disinfection (.590). Comparatively speaking, there is a large disparity between the capital costs for the two alternatives, $123.4MM for tunnel storage and $69.4MM for a screening and disinfection facility. Sewer separation also has an objective score (.586) that is very close to that of tunnel storage and screening and disinfection. The cost for separation is $579.6MM which makes this solution financially irresponsible to construct or consider further.

Alternative AS-2

Alternative AS-2 is based upon Tunnel AS-2, having an approximate length of 31,750 feet. *Attachment 3 – Subsystem Alternative AS-2* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Allegheny South system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel AS-2 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 230.41 MG to 47.72 MG for control levels of 0 to 6 overflow events, respectively. *Figure 2 – AS-2 Region CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

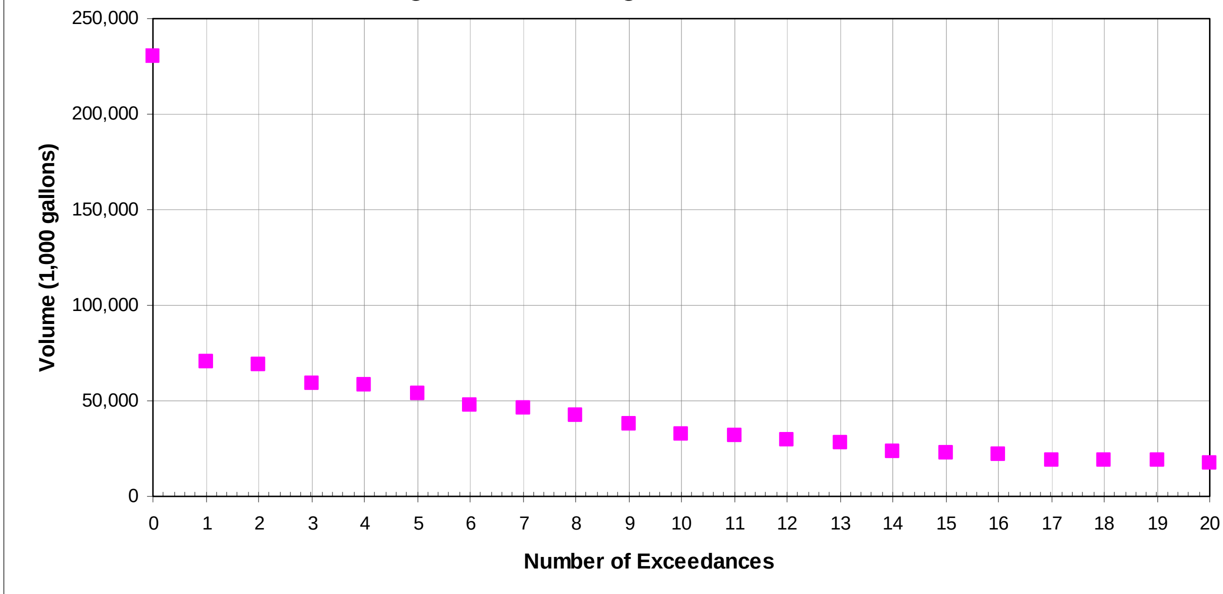


Figure 2 - AS-2 Region CSO Volume

Table 3 - Alternative AS-2 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 3: Alternative AS-2 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Downtown Allegheny	A-1 thru A-15	270	94	Tunnel AS-2
Strip District	A-16 thru A-21	440		
Two Mile Run	A-22 and A-23	1,880		
Lawrenceville	A-25 thru A-37A	1,450		
Heths Run	A-38, A-40 and A-41, DC121L001	780		
Negley Run	A-42 / A-42A	2,885	78	Screening & Disinfection

<u>Tunnel AS-2</u>

The Allegheny South Tunnel AS-2 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers A-01 to A-41. A pump station will be constructed in the vicinity of A-01 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 230.5 MGD for 0 overflows to 48 MGD for 6 overflows. Assuming a tunnel length of approximately 6.0 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 20 feet.

Other important components of Tunnel AS-2 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel alignment to convey flow from overflow structures to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 4 - Tunnel AS-2 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates of the drop shafts at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts. No significant consolidation sewers are anticipated to be constructed in association with this tunnel segment. New drop shafts will be constructed adjacent to existing ALCOSAN regulating structures.

Table 4: Alternative AS-2 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-1	Near A-01	A-01	6.78	N/A	N/A
AS-2	Near A-02	A-02	0.91	N/A	N/A
AS-3	Near A-03	A-03	1.35	N/A	N/A
AS-4	Near A-04	A-04	18.92	N/A	N/A
AS-5	Near A-05	A-05	3.36	N/A	N/A
AS-6	Near A-06	A-06	9.31	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-7	Near A-07	A-07	5.83	N/A	N/A
AS-8	Near A-08	A-08	0.28	N/A	N/A
AS-9	Near A-09	A-09	21.24	N/A	N/A
AS-10	Near A-10	A-10	8.68	N/A	N/A
AS-11	Near A-11	A-11	4.86	N/A	N/A
AS-12	Near A-12	A-12	31.53	N/A	N/A
AS-13	Near A-13	A-13	9.84	N/A	N/A
AS-13A	Near A-13A	A-13A	9.36	N/A	N/A
AS-14	Near A-14	A-14	23.70	N/A	N/A
AS-14A	Near A-14A	A-14A	0.73	N/A	N/A
AS-15	Near A-15	A-15	13.52	N/A	N/A
AS-16	Near A-16	A-16	16.62	N/A	N/A
AS-17	Near A-17	A-17	19.85	N/A	N/A
AS-17A	Near A-17A	A-17A	2.49	N/A	N/A
AS-17B	Near A-17B	A-17B	2.10	N/A	N/A
AS-18	Near A-18	A-18	34.83	N/A	N/A
AS-18A	Near A-18A	A-18A	10.07	N/A	N/A
AS-18B	Near A-18B	A-18B	3.70	N/A	N/A
AS-19	Near A-19	A-19	26.91	N/A	N/A
AS-19A	Near A-19A	A-19A	31.58	N/A	N/A
AS-19B	Near A-19B	A-19B	2.07	N/A	N/A
AS-20	Near A-20	A-20	43.06	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-21	Near A-21	A-21	59.38	N/A	N/A
AS-22	Near A-22	A-22	766.30	N/A	N/A
AS-23	Near A-23	A-23	261.67	N/A	N/A
AS-25	Near A-25	A-25	38.99	N/A	N/A
AS-26	Near A-26	A-26	64.49	N/A	N/A
AS-27	Near A-27	A-27	36.59	N/A	N/A
AS-27A	Near A-27A	A-27A	16.82	N/A	N/A
AS-28	Near A-28	A-28	119.40	N/A	N/A
AS-29	Near A-29	A-29	75.06	N/A	N/A
AS-29A	Near A-29A	A-29A	106.54	N/A	N/A
AS-30	Near A-30	A-30	12.95	N/A	N/A
AS-31	Near A-31	A-31	16.86	N/A	N/A
AS-32	Near A-32	A-32	46.57	N/A	N/A
AS-33	Near A-33	A-33	41.02	N/A	N/A
AS-34	Near A-34	A-34	29.13	N/A	N/A
AS-35	Near A-35	A-35	87.25	N/A	N/A
AS-36	Near A-36	A-36	19.87	N/A	N/A
AS-37	Near A-37	A-37	7.24	N/A	N/A
AS-37A	Near A-37A	A-37A	21.29	N/A	N/A
AS-38	Near A-38	A-38	5.12	N/A	N/A
AS-40	Near A-40	A-40	20.16	N/A	N/A
AS-41	Near A-41	A-41	219.09	N/A	N/A

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the AS-2 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Allegheny River. Approximately 1.5 acres of land will be required to accommodate a dewatering pump station and ancillary facilities

Attachment 4 - Subsystem Alternative AS-2, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>Negley Run Region</u> CSOs from this portion of Alternative AS-2 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

Although Tunnel Storage was the highest rated CSO control alternative, it was decided that screening and disinfection would be a more viable option for two reasons. First, there is very little difference in the objective scoring between tunnel storage (.604) and screening and disinfection (.590). Comparatively speaking, there is a large disparity between the capital cost for the two alternatives, $123.4MM for tunnel storage and $69.4MM for a screening and disinfection facility. Sewer separation also has an objective score (.586) that is very close to that of tunnel storage and screening and disinfection. However, the cost for separation is $579.6MM which makes this solution financially irresponsible to construct or consider further.

Alternative AS-3

Alternative AS-3 is based upon Tunnel AS-3, having an approximate length of 34,750 feet. *Attachment 5 – Subsystem Alternative AS-3* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Allegheny South system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel AS-3 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 499.78 MG to 73.35 MG for control levels of 0 to 6 overflow events, respectively. *Figure 3 – AS-3 Region CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

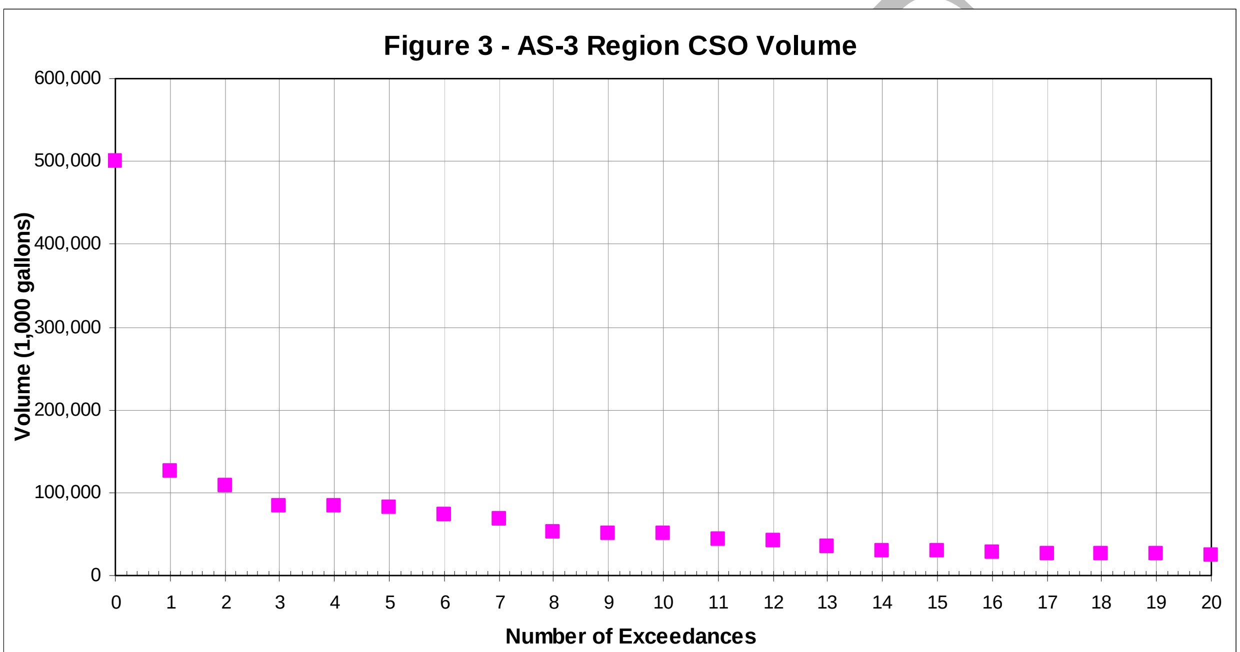


Table 5 - Alternative AS-3 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 5: Alternative AS-3 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Downtown Allegheny	A-1 thru A-15	270	93	Tunnel AS-3
Strip District	A-16 thru A-21	440		
Two Mile Run	A-22 and A-23	1,880		
Lawrenceville	A-25 thru A-37A	1,450		
Heths Run	A-38, A-40 and A-41, DC121L001	780		
Negley Run	A-42 / A-42A	2,885		

Tunnel AS-3

The Allegheny South Tunnel AS-3 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers A-01 to A-42. A pump station will be constructed in the vicinity of A-01 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 500 MGD for 0 overflows to 74.5 MGD for 6 overflows. Assuming a tunnel length of approximately 6.6 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 23 feet.

Other important components of Tunnel AS-3 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel alignment to convey flow from overflow structures to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 6 - Tunnel AS-3 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates of the drop shafts at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts. No significant consolidation sewers are anticipated to be constructed in association with this tunnel segment. New drop shafts will be constructed adjacent to existing ALCOSAN regulating structures.

Table 6: Alternative AS-3 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-1	Near A-01	A-01	6.78	N/A	N/A
AS-2	Near A-02	A-02	0.91	N/A	N/A
AS-3	Near A-03	A-03	1.35	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-4	Near A-04	A-04	18.92	N/A	N/A
AS-5	Near A-05	A-05	3.36	N/A	N/A
AS-6	Near A-06	A-06	9.31	N/A	N/A
AS-7	Near A-07	A-07	5.83	N/A	N/A
AS-8	Near A-08	A-08	0.28	N/A	N/A
AS-9	Near A-09	A-09	21.24	N/A	N/A
AS-10	Near A-10	A-10	8.68	N/A	N/A
AS-11	Near A-11	A-11	4.86	N/A	N/A
AS-12	Near A-12	A-12	31.53	N/A	N/A
AS-13	Near A-13	A-13	9.84	N/A	N/A
AS-13A	Near A-13A	A-13A	9.36	N/A	N/A
AS-14	Near A-14	A-14	23.70	N/A	N/A
AS-14A	Near A-14A	A-14A	0.73	N/A	N/A
AS-15	Near A-15	A-15	13.52	N/A	N/A
AS-16	Near A-16	A-16	16.62	N/A	N/A
AS-17	Near A-17	A-17	19.85	N/A	N/A
AS-17A	Near A-17A	A-17A	2.49	N/A	N/A
AS-17B	Near A-17B	A-17B	2.10	N/A	N/A
AS-18	Near A-18	A-18	34.83	N/A	N/A
AS-18A	Near A-18A	A-18A	10.07	N/A	N/A
AS-18B	Near A-18B	A-18B	3.70	N/A	N/A
AS-19	Near A-19	A-19	26.91	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-19A	Near A-19A	A-19A	31.58	N/A	N/A
AS-19B	Near A-19B	A-19B	2.07	N/A	N/A
AS-20	Near A-20	A-20	43.06	N/A	N/A
AS-21	Near A-21	A-21	59.38	N/A	N/A
AS-22	Near A-22	A-22	766.30	N/A	N/A
AS-23	Near A-23	A-23	261.67	N/A	N/A
AS-25	Near A-25	A-25	38.99	N/A	N/A
AS-26	Near A-26	A-26	64.49	N/A	N/A
AS-27	Near A-27	A-27	36.59	N/A	N/A
AS-27A	Near A-27A	A-27A	16.82	N/A	N/A
AS-28	Near A-28	A-28	119.40	N/A	N/A
AS-29	Near A-29	A-29	75.06	N/A	N/A
AS-29A	Near A-29A	A-29A	106.54	N/A	N/A
AS-30	Near A-30	A-30	12.95	N/A	N/A
AS-31	Near A-31	A-31	16.86	N/A	N/A
AS-32	Near A-32	A-32	46.57	N/A	N/A
AS-33	Near A-33	A-33	41.02	N/A	N/A
AS-34	Near A-34	A-34	29.13	N/A	N/A
AS-35	Near A-35	A-35	87.25	N/A	N/A
AS-36	Near A-36	A-36	19.87	N/A	N/A
AS-37	Near A-37	A-37	7.24	N/A	N/A
AS-37A	Near A-37A	A-37A	21.29	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
AS-38	Near A-38	A-38	5.12	N/A	N/A
AS-40	Near A-40	A-40	20.16	N/A	N/A
AS-41	Near A-41	A-41	219.09	N/A	N/A
AS-42	Near A-42	A-42	831.60	N/A	N/A

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the AS-3 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Allegheny River. Approximately 2 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 6 - Subsystem Alternative AS-3, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

Alternative Evaluation Results

Table 7 – Allegheny South Subsystem Alternative Costs illustrates the planning level capital, O&M and present worth costs associated with alternatives AS-1, AS-2 and AS-3 when sized for 4 untreated overflow events per year.

Table 7: Allegheny South Subsystem Alternative Costs

Subsystem	Capital Cost (MM$)	Annual O&M Cost (MM$)	PW Cost (MM$)
AS-1	$359.2	$4.6	$410.8
AS-2	$373.8	$4.7	$426.2
AS-3	$392.7	$4.4	$441.9

For the purpose of this DRAFT Feasibility Study, the above alternatives were further evaluated based on a combination of their economic, environmental, implementation, and operational impacts over a range of CSO control levels corresponding to 4 untreated overflows per year.

Attachment 7 – Allegheny South Subsystem Alternatives Scoring Sheet illustrates the composite scoring of economic, environmental, implementation, and operational evaluation factors for control levels of 4 overflows per year. Complete details of the economic evaluation and the composite scoring of economic, environmental, implementation, and operational evaluation factors can be found in Appendix F.

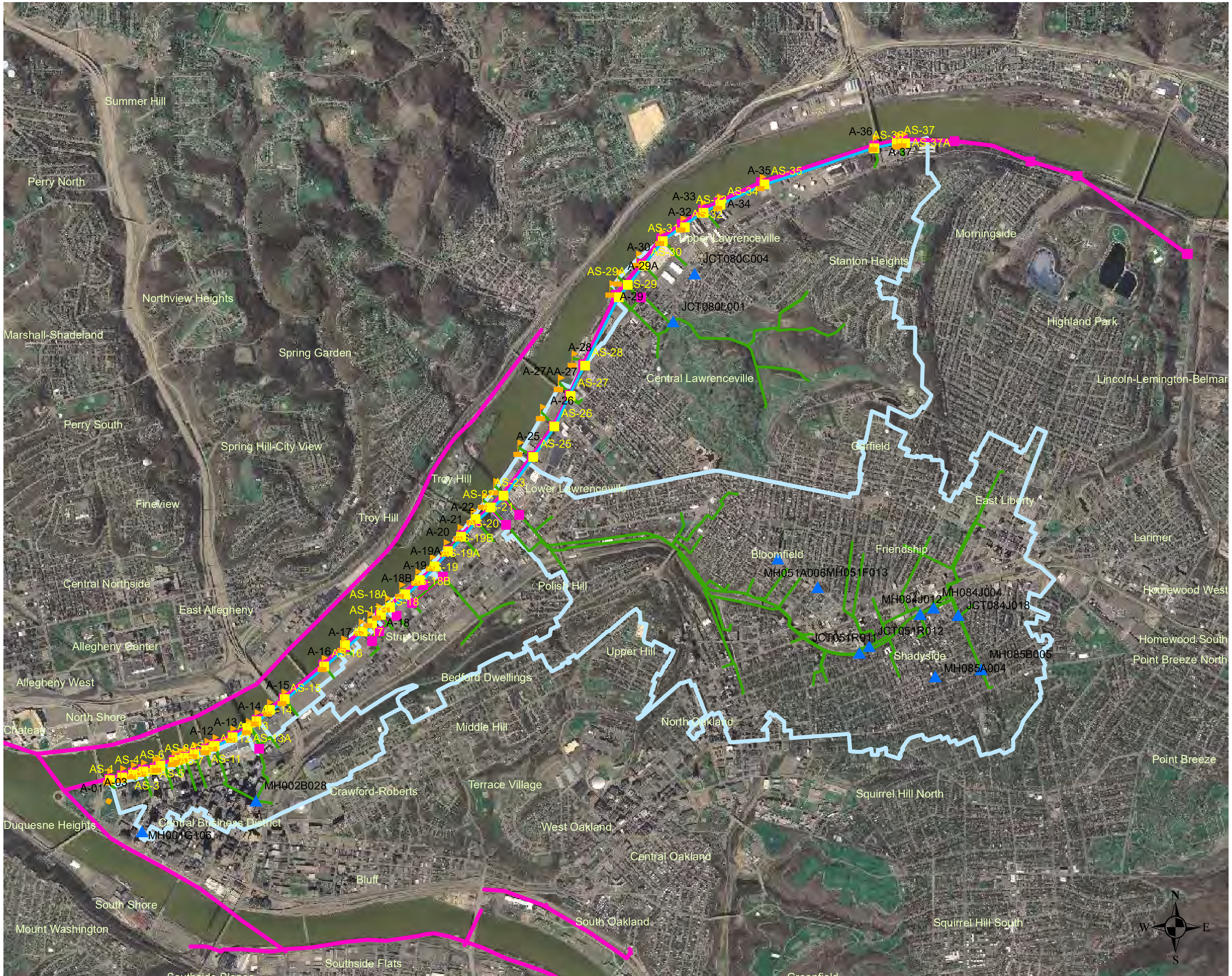
Recommendations

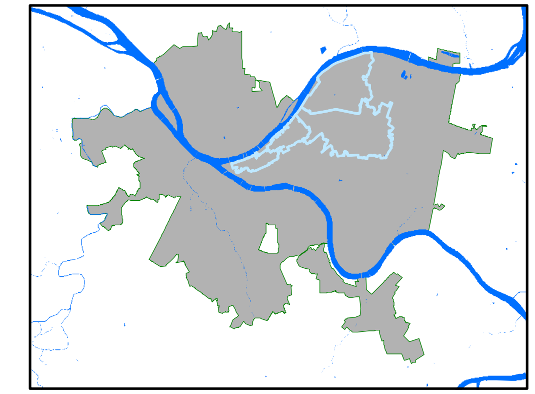
It is recommended that the following alternative be carried forward as part of the overall System-Wide alternative.

- AS-3. This alternative resulted in the highest score for control level of 4 events per year.

Significant Issues

Some issues exist with the siting of a tunnel. It appears that there is some space for the facilities associated with the tunnel, however, there is significant infrastructure at intermittent locations along the entire length of the tunnel alignment. Detailed geotechnical studies would have to be completed to determine the suitability of the underlying subsurface conditions for tunnel construction. In addition, construction of drop shafts will be a significant endeavor considering the congested infrastructure and natural features that exist in the areas where the sewers would be constructed. In addition to detailed geotechnical studies, permitting and land acquisition would determine the final location of these facilities if this alternative is selected for implementation. Issues associated with the outlier outfalls are presented in the Outfall Specific or the Regional Analysis appendices.





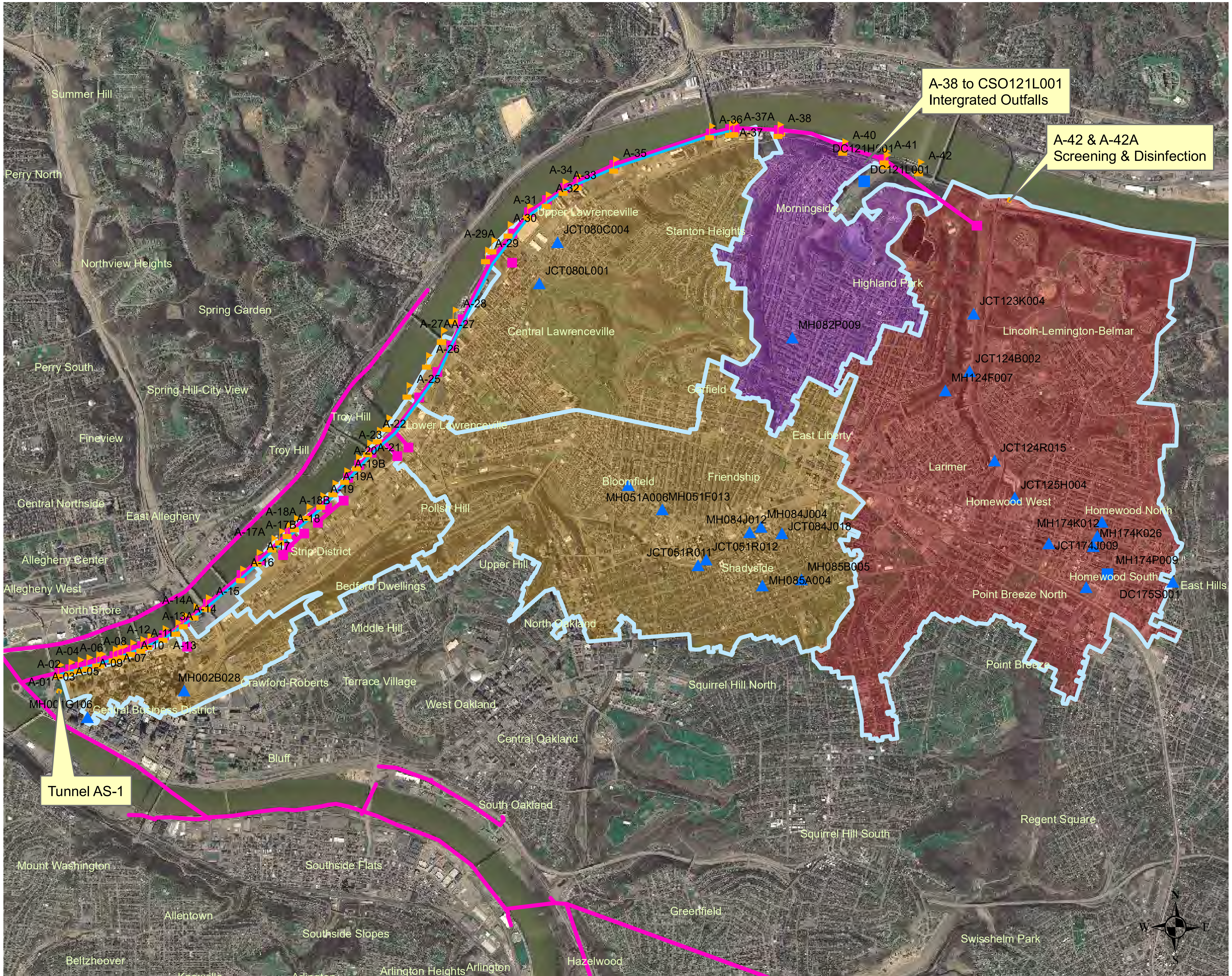
Legend

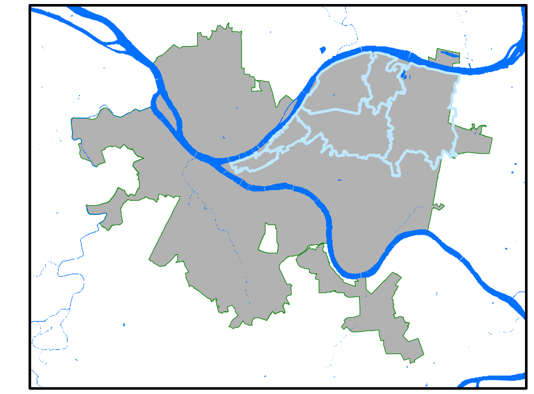
- Sewershed Boundary
- Facility Boundary
- Tunnel AS-1
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

3,000 0 3,000 Feet

Attachment 1 Subsystem Alternative AS-1 Tunnel Portion

CSO Control Alternatives





Legend

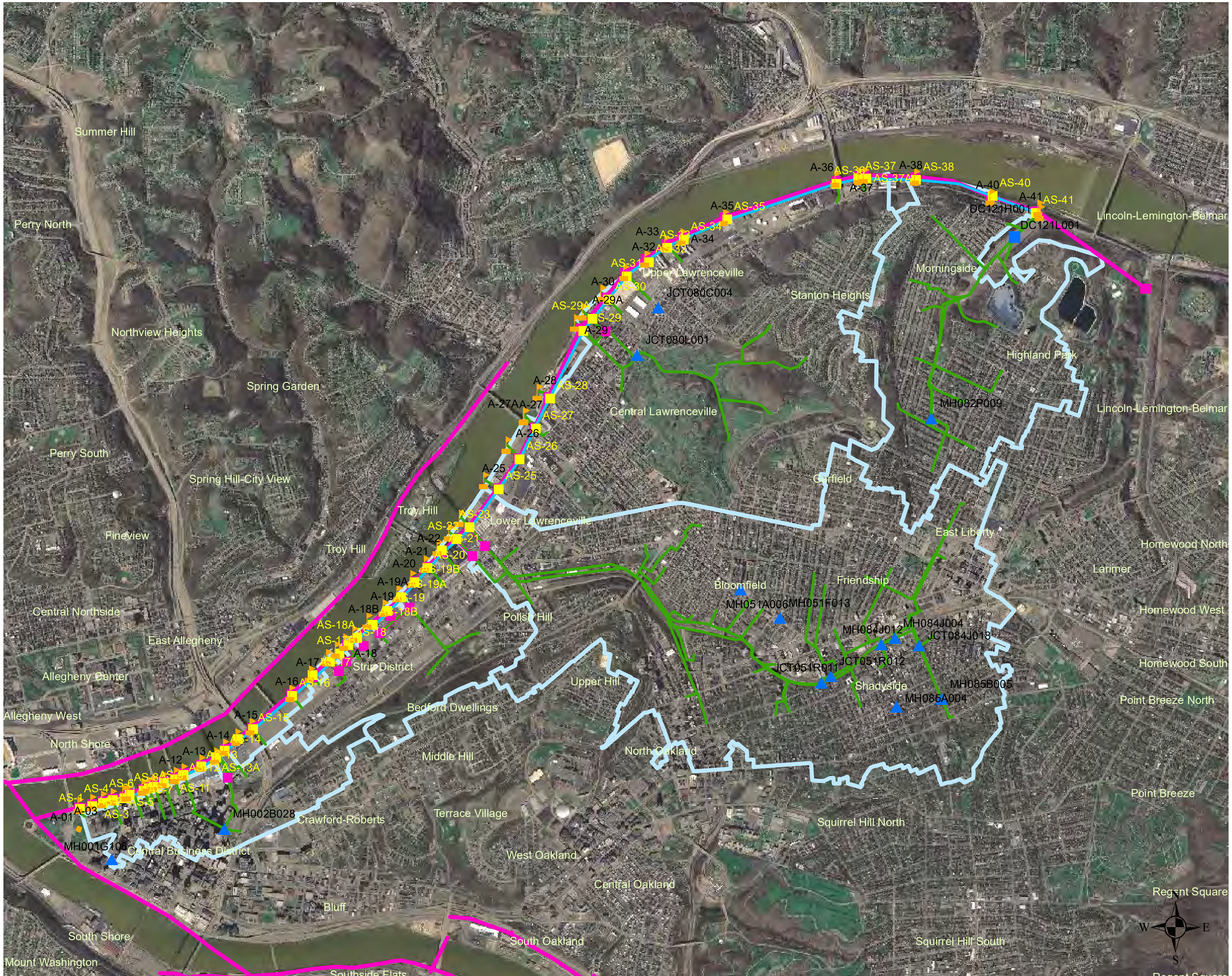
- Tunnel Storage
- Intergrated Outfalls
- Screening & Disinfection
- Sub-Surface Storage
- Sewershed Boundary
- Facility Boundary
- Tunnel AS-1
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- PWSA Flow Divider
- Combined Sewer Outfall

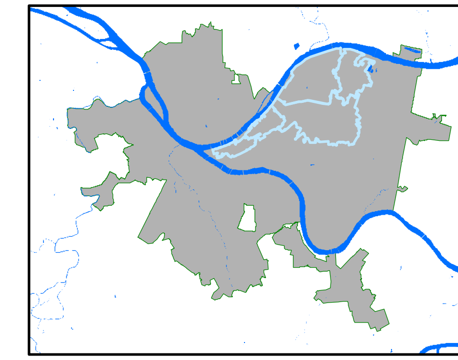
4,000 0 4,000 Feet

Attachment 2 Subsystem Alternative AS-1

CSO Control Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

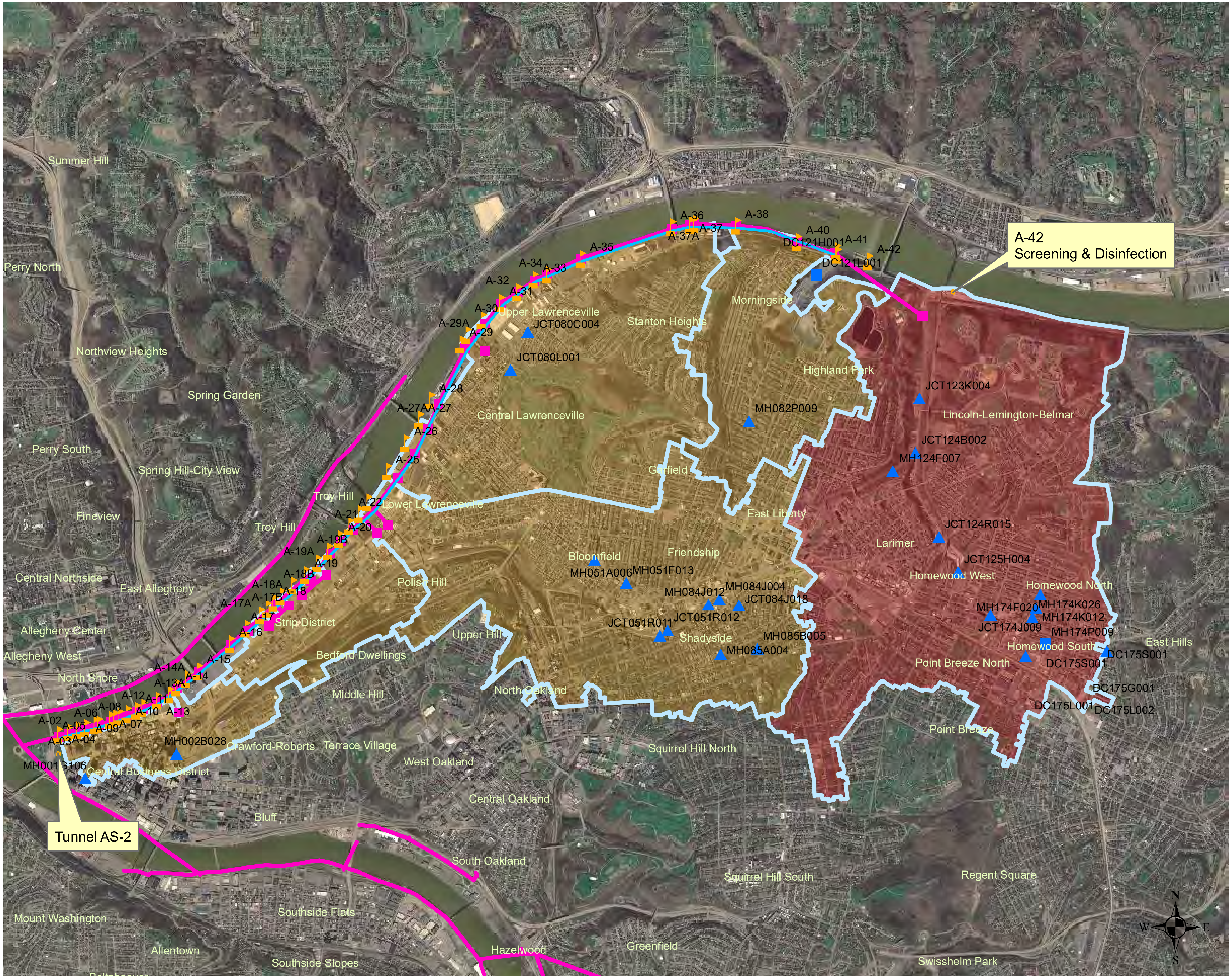
- Sewershed Boundary
- Facility Boundary
- Tunnel AS-2
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

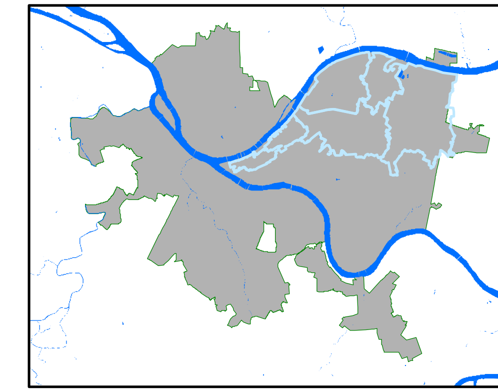
3,000 0 3,000 Feet

Attachment 3 Subsystem Alternative AS-2 Tunnel Portion

CSO Control Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

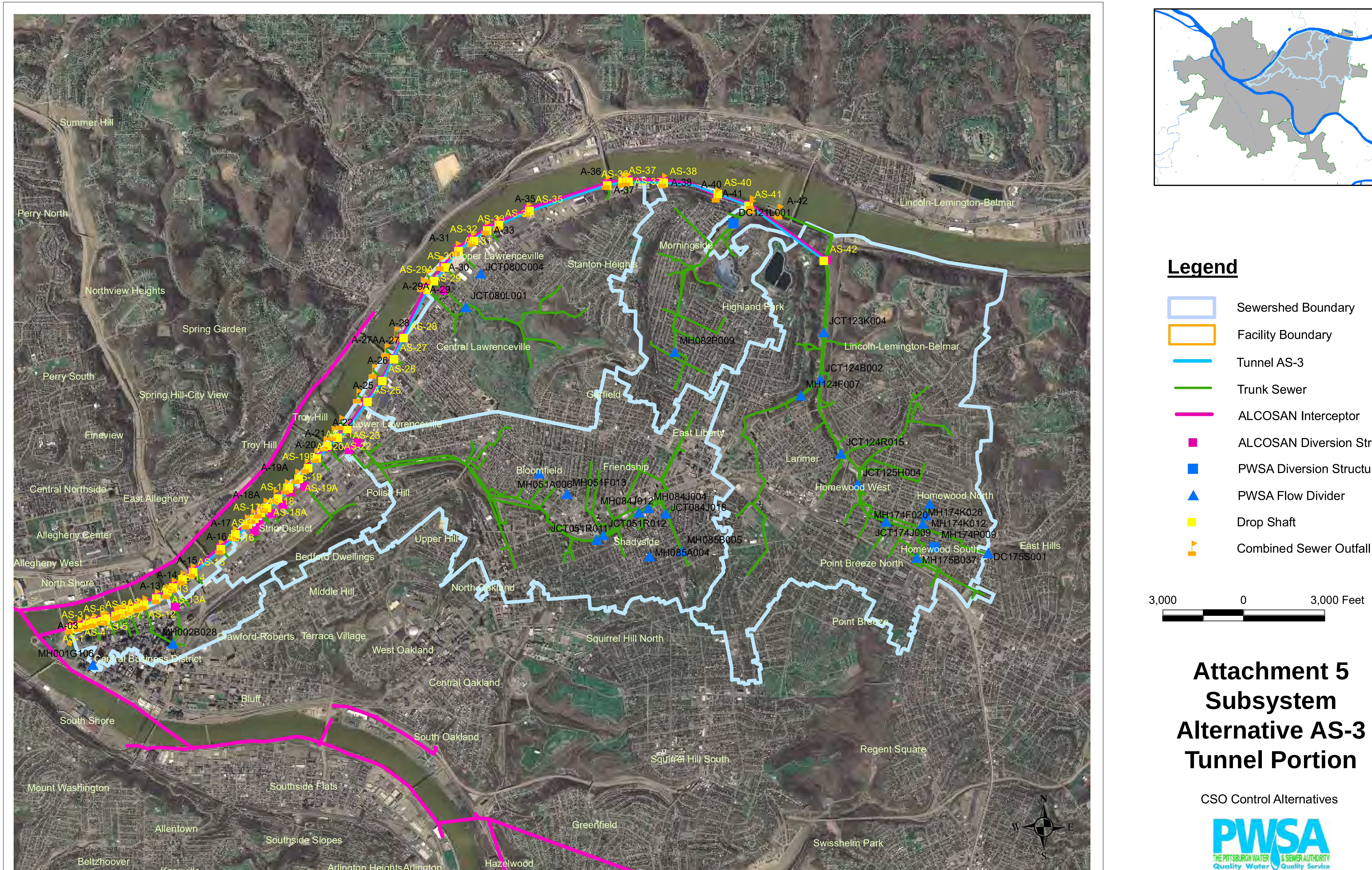
- Tunnel Storage
- Screening & Disinfection
- Sub-Surface Storage
- Sewershed Boundary
- Facility Boundary
- Tunnel AS-2
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- PWSA Flow Divider
- Combined Sewer Outfall

4,000 0 4,000 Feet

Attachment 4 Subsystem Alternative AS-2

CSO Control Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service



Legend

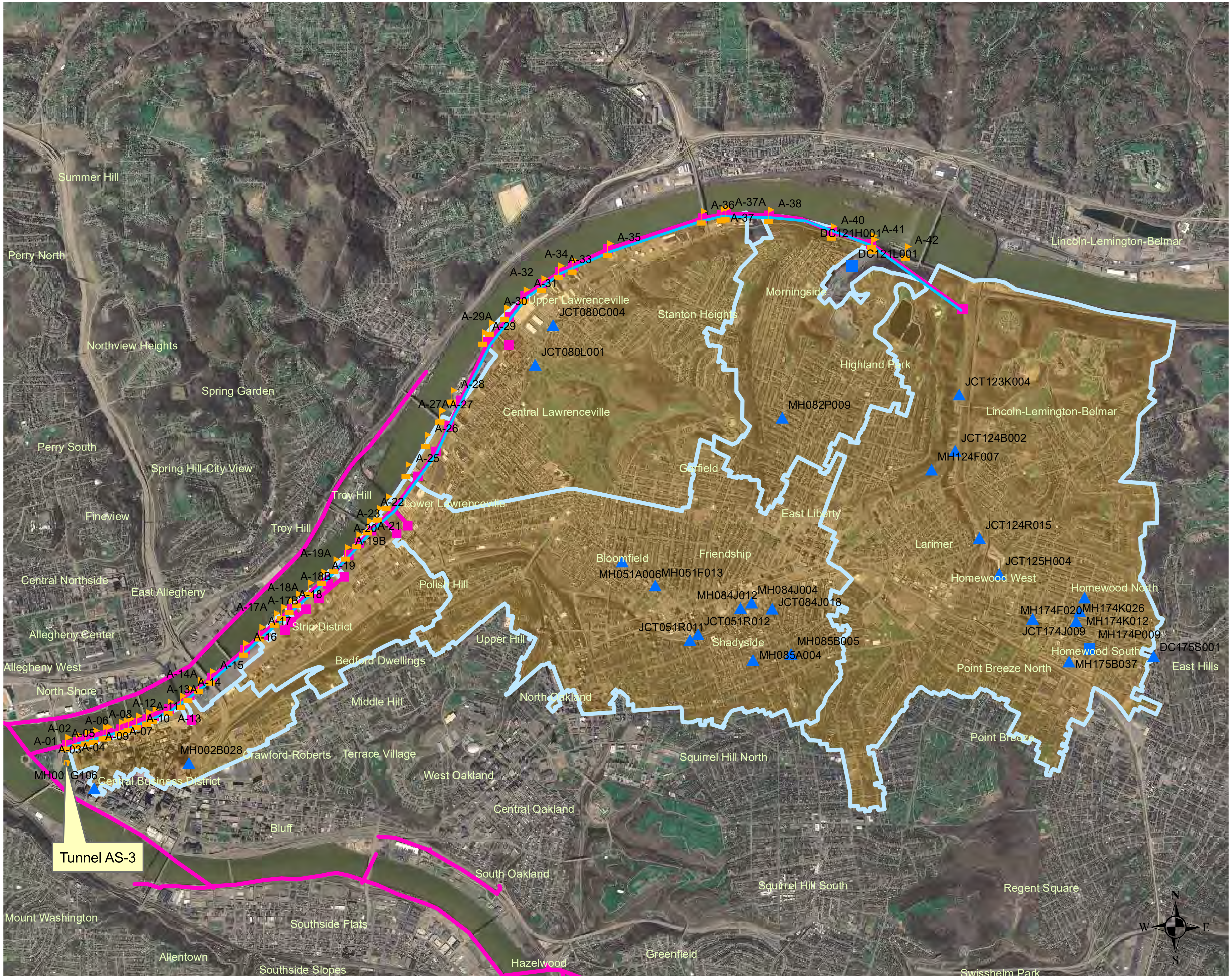
- Sewershed Boundary
- Facility Boundary
- Tunnel AS-3
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

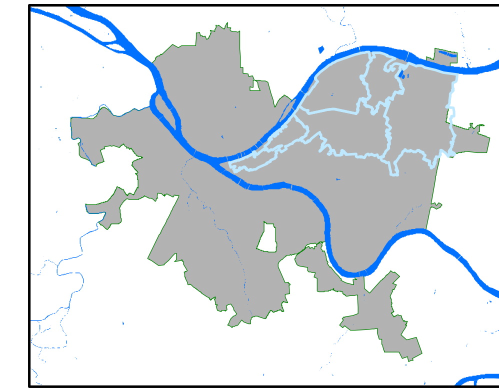
3,000 0 3,000 Feet

Attachment 5 Subsystem Alternative AS-3 Tunnel Portion

CSO Control Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

- Tunnel Storage
- Sewershed Boundary
- Facility Boundary
- Tunnel AS-3
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- PWSA Flow Divider
- Combined Sewer Outfall

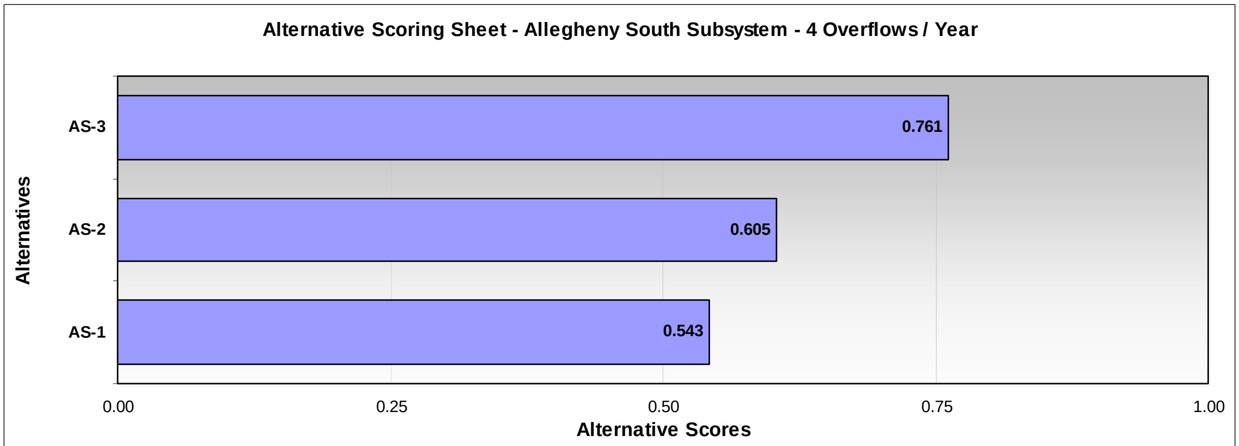
4,000 0 4,000 Feet

Attachment 6 Subsystem Alternative AS-3

CSO Control Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

Attachment 7 – Allegheny South Subsystem Alternative Scoring Sheet



MO-1				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 89,302,000
TUNNEL STORAGE (O-25 thru O-27, O-29 thru O-43, M-1 thru M-5, M-6 thru M-8, M-9 thru M-17, M-19)				
	O-25 thru O-27 Brighton Hts, O-29 thru O-43 California-Kirkbride, M-1 thru M-5 Downtown Mon, M-6 thru M-8 Southside Slopes, M-9 thru M-17 Southside Slopes, M-19, M-19A, B, C & D 2nd Ave			
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Boundary Street (M-29)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	21.4 MG	Surface Storage	$ 111.3	$ 98,443,000
Hazelwood (M-31 thru M-40)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	4.6 MG	Tunnel Storage	$ 51.1	$ 45,561,000
Nine Mile Run (M-47)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	19.0 MDG	Screening & Disinfection	$ 10.6	$7,936,000
Upper Nine Mile Run (DC175)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	27.4 MDG	Sub-Surface Storage	$ 8.0	$6,770,000
Nine Mile Run-Frick Park (128R002)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	5.4 MDG	Sub-Surface Storage	$ 9.5	$8,151,000
Beck's Run (M-34)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	6.07 MG	Surface Storage	$ 16.0	$ 13,296,000
Street's Run (M-42)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	17.66 MGD	Screening & Disinfection	$ 22.9	$ 20,192,000
CSO 030N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.04 MGD	Sewer Separation	$ 1.7	$ 1,699,000
CSO 032N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.02 MG	Sub-Surface Storage	$ 2.3	$ 1,935,000

MO-2				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 89,302,000
TUNNEL STORAGE (M-01 Outfalls plus M-29)				
	M-01 Outfalls plus M-29 Boundary Street			
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Boundary Street (M-29)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Hazelwood (M-31 thru M-40)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	4.6 MG	Tunnel Storage	$ 51.1	$ 45,561,000
Nine Mile Run (M-47)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	19.0 MDG	Screening & Disinfection	$ 10.6	$ 7,936,000
Upper Nine Mile Run (DC175)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	27.4 MDG	Sub-Surface Storage	$ 8.0	$ 6,770,000
Nine Mile Run-Frick Park (128R002)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	5.4 MDG	Sub-Surface Storage	$ 9.5	$ 8,151,000
Beck's Run (M-34)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	6.07 MG	Surface Storage	$ 16.0	$ 13,296,000
Street's Run (M-42)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	17.66 MGD	Screening & Disinfection	$ 22.9	$ 20,192,000
CSO 030N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.04 MGD	Sewer Separation	$ 1.7	$ 1,699,000
CSO 032N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.02 MG	Sub-Surface Storage	$ 2.3	$ 1,935,000

MO-3				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 90,180,000
TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40 and M-34)				
	M-02a Outfalls plus M-31 thru M-40 Hazelwood and M-34 Beck's Run			
RIVER CROSSING #1 - Microtunnel				
	M-34 Beck's Run			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Boundary Street (M-29)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Hazelwood (M-31 thru M-40)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Nine Mile Run (M-47)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	19.0 MDG	Screening & Disinfection	$ 10.6	$ 7,936,000
Upper Nine Mile Run (DC175)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	27.4 MDG	Sub-Surface Storage	$ 8.0	$ 6,770,000
Nine Mile Run-Frick Park (128R002)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	5.4 MDG	Sub-Surface Storage	$ 9.5	$ 8,151,000
Beck's Run (M-34)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Street's Run (M-42)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	17.66 MGD	Screening & Disinfection	$ 22.9	$ 20,192,000
CSO 030N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.04 MGD	Sewer Separation	$ 1.7	$ 1,699,000
CSO 032N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.02 MG	Sub-Surface Storage	$ 2.3	$ 1,935,000

Alternative Menu

MO-4				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 105,724,000
TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40, M-34 and M-42)				
	M-03 Outfalls plus M-42 Street's Run			
RIVER CROSSING #1 - Microtunnel				
	M-34 Beck's Run			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Boundary Street (M-29)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Hazelwood (M-31 thru M-40)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Nine Mile Run (M-47)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	19.0 MDG	Screening & Disinfection	$ 10.6	$ 7,936,000
Upper Nine Mile Run (DC175)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	27.4 MDG	Sub-Surface Storage	$ 8.0	$ 6,770,000
Nine Mile Run-Frick Park (128R002)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	5.4 MDG	Sub-Surface Storage	$ 9.5	$ 8,151,000
Beck's Run (M-34)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Street's Run (M-42)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
CSO 030N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.04 MGD	Sewer Separation	$ 1.7	$ 1,699,000
CSO 032N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.02 MG	Sub-Surface Storage	$ 2.3	$ 1,935,000

MO-5				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 105,724,000
TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40, M-34, M-42 and M-47)				
	M-04 Outfalls plus M-47 Nine Mile Run and DC175 Upper Nine Mile Run			
RIVER CROSSING #1 - Microtunnel				
	M-34 Beck's Run			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Boundary Street (M-29)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Hazelwood (M-31 thru M-40)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Nine Mile Run (M-47)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Upper Nine Mile Run (DC175)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	27.4 MDG	Sub-Surface Storage	$ 8.0	$ 6,770,000
Nine Mile Run-Frick Park (128R002)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	5.4 MDG	Sub-Surface Storage	$ 9.5	$ 8,151,000
Beck's Run (M-34)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Street's Run (M-42)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
CSO 030N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.04 MGD	Sewer Separation	$ 1.7	$ 1,699,000
CSO 032N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.02 MG	Sub-Surface Storage	$ 2.3	$ 1,935,000

MO-6				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 89,302,000
TUNNEL STORAGE (M-01 Outfalls w/ River Crossing)				
	M-01 Outfalls plus River Crossing (M-19), M-29 Boundary Street, M-47 Nine Mile Run and DC175 Upper Nine Mile Run			
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
SUBSYSTEM COMPONENTS - REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
Boundary Street (M-29)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Hazelwood (M-31 thru M-40)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	4.6 MG	Tunnel Storage	$ 51.1	$ 45,561,000
Nine Mile Run (M-47)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
Upper Nine Mile Run (DC175)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	27.4 MDG	Sub-Surface Storage	$ 8.0	$ 6,770,000
Nine Mile Run-Frick Park (128R002)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	5.4 MDG	Sub-Surface Storage	$ 9.5	$ 8,151,000
Beck's Run (M-34)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	6.07 MG	Surface Storage	$ 16.0	$ 13,296,000
Street's Run (M-42)				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	17.66 MGD	Screening & Disinfection	$ 22.9	$ 20,192,000
CSO 030N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.04 MGD	Sewer Separation	$ 1.7	$ 1,699,000
CSO 032N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.02 MG	Sub-Surface Storage	$ 2.3	$ 1,935,000

Objective Scoring

Alternative:	**MO-1**	**Objective Scoring: Present Worth**	**Actual Scores**
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	4
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	**MO-1**	**Objective Scoring: Pollution Reduction**	**Actual Scores**
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	4
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	**MO-1**	**Objective Scoring: Impact on Habitat, Stream, River etc.**	**Actual Scores**
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	4
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	MO-1	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	2
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	MO-1	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	2
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	MO-1	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	3
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Alternative:	MO-1	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	MO-1	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	MO-1	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	2
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Alternative:	MO-1	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	MO-1	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	3
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	MO-1	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	2
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Alternative:	MO-1	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	MO-2	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	5
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	MO-2	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	4
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	MO-2	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	4
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	MO-2	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	2
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	MO-2	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	2
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	MO-2	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	3
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	MO-2	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	MO-2	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	MO-2	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	2
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	MO-2	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	MO-2	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	3
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	MO-2	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	2
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Alternative:	MO-2	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team
Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	MO-3	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	5
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	MO-3	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	4
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	MO-3	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	4
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	MO-3	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surfac impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	2
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Sit specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	MO-3	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	2
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	MO-3	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	MO-3	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	MO-3	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	MO-3	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	2
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	MO-3	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restriction and ease of facility expansion to be considered.	3
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	MO-3	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	3
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	MO-3	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	2
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	MO-3	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Alternative:	MO-4	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	5
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	MO-4	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	4
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	MO-4	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	4
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	MO-4	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	2
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	MO-4	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	2
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	MO-4	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	MO-4	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	MO-4	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	MO-4	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	3
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	MO-4	Objective Scoring: Flexibility	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	MO-4	Objective Scoring: Reliability	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	3
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	MO-4	Objective Scoring: Compatibility	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	2
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Alternative:	MO-4	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	MO-5	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	5
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	MO-5	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	4
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	MO-5	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	4
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	MO-5	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	3
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	MO-5	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	3
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	MO-5	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Alternative:	MO-5	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	3
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	MO-5	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	MO-5	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	4
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	MO-5	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	MO-5	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	5
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	MO-5	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	3
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	MO-5	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	3
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	MO-6	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	5
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	MO-6	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	4
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP.	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	MO-6	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	4
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs.	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Alternative:	MO-6	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption t traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	2
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and materia delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	MO-6	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	2
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	MO-6	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	MO-6	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	MO-6	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	MO-6	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	2
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Alternative:	MO-6	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	MO-6	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	3
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	MO-6	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	2
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Alternative:	MO-6	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Total Score

Alternative:	MO-1		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	4	0.75	0.147	0.110
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.545**

Total Score

Alternative:	MO-2		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.582**

Total Score

Alternative:	MO-3		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.582**

Total Score

Alternative:	MO-4		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.608**

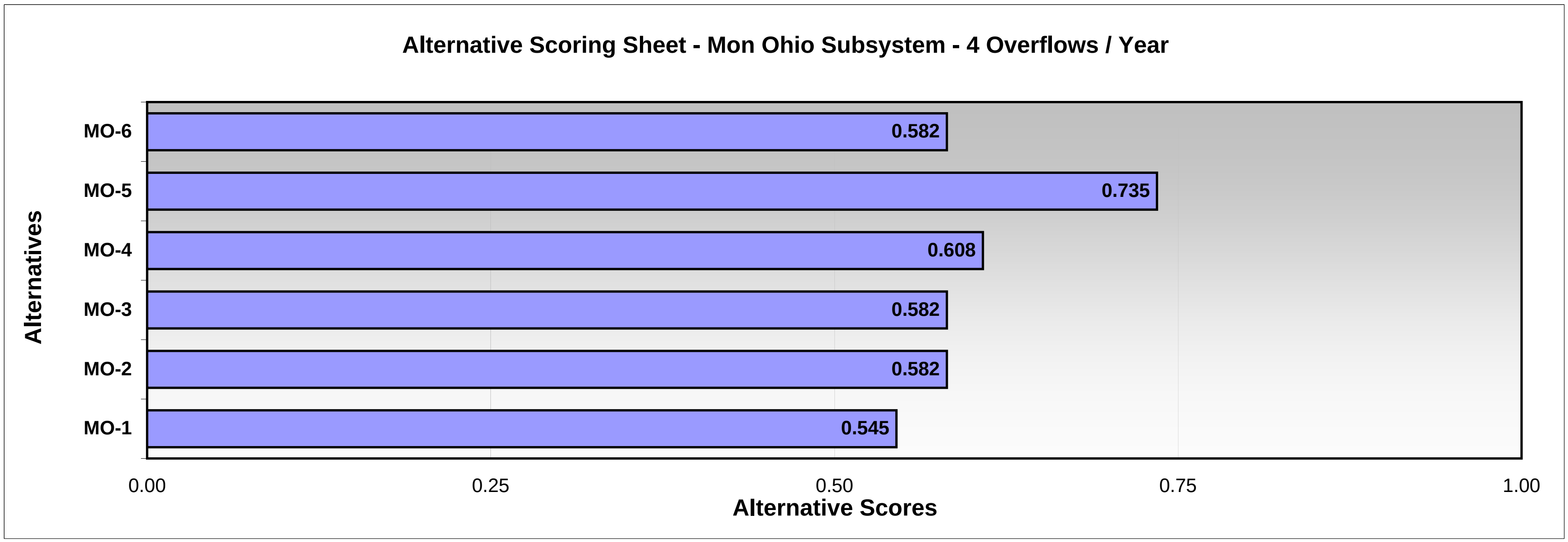
Total Score

Alternative:	MO-5		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.735**

Total Score

Alternative:	MO-6		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	4	0.85	0.108	0.092
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.582**

Alternative Scoring Sheet



RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	134	
Peak Volume	4,571,493	CF
	34.19	MG
Total Volume	97,996,239	CF
	733.01	MG
Peak Rate	1,587.16	CFS
	1025.74	MGD

CONSOLIDATION SEWERS - Total	
134 Overflows / Year	
SUBTOTAL CAPITAL COST $	**89,302,000**

TUNNEL STORAGE (O-25 thru O-27, O-29 thru O-43, M-1 thru M-5, M-6 thru M-8, M-9 thru M-17, M-19)			
134 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	34.19	4,571,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	42.74	5,714,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	24		Input by Engineer
Tunnel Volume / Ft length (CF)	452.16		Ref: Tunnel diameter
Tunnel Length (Ft)	12,637		= Req'd Fac Vol / Vol per Ft Length; Target length is 12,700 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	6	6	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MGD)	5	7	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**123,446,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	34.19	52.91	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	40		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	6.1	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	150		Input by Engineer
Construction Cost (PS / Force Main) $	**8,810,000**	**$ 72,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	264.53		Peak Flow / # drop shaft
Diameter (In)	108		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	-		75' per drop shaft
Average Depth (Ft)	20		Input by Engineer
Construction Cost (Consolidation Pipe) $	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	8,571,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	428,550		= ACH x Volume / 60
Construction Cost (Odor Control) $	**10,575,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	34.19		Ref: CSO Statistics
Construction Cost (Screening) $	**1,996,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	34.19		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	17.10		= Peak Vol/DW Time
Construction Cost $	**16,323,783**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	18		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**23,130,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	45,000		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	8,549		250 SF / MGD
Land Required - Odor Control (SF)	21,428		500 SF / 10,000 CFM
Land Required - Screening (SF)	8,549		250 SF / MGD
Land Required - Regulator (SF)	180,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*264,000*		
Land Required Cost (/ SF)	$ 2		Ref: Technical Parameters
Land Acquisition Cost $	**528,000**		
SUBTOTAL CAPITAL COST $			**184,880,783**

RESULTS SUMMARY			
Number of Events / Year	4		
Number of Overflows / Year	134		
Peak Volume	6,978,546	CF	
	52.20	MG	
Total Volume	168,155,903	CF	
	1257.81	MG	
Peak Rate	1,640.53	CFS	
	1060.23	MGD	

CONSOLIDATION SEWERS - Total		
134 Overflows / Year		
SUBTOTAL CAPITAL COST	$	89,302,000

TUNNEL STORAGE (M-01 Outfalls plus M-29)				
134 Overflows / Year				
1. Tunnel Parameters				
Tunnel Type (1=Rock; 2=Soft Ground)		1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		52.20	6,979,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)		65.25	8,724,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		27		Input by Engineer
Tunnel Volume / Ft length (CF)		572.27		Ref: Tunnel diameter
Tunnel Length (Ft)		15,245		= Req'd Fac Vol / Vol per Ft Length; Target length is 15,500 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		8	8	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MGD)		5	6	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**169,682,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters				
Volume Requiring Pumping (%)		100%		Ref: Technical Parameters
Dewatering Time (Days)		1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		52.20	80.77	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		50		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		5.9	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		150		Input by Engineer
Construction Cost (PS / Force Main)	**$**	**13,476,000**	**$ 89,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)				
Peak Flow (CFS) per Vortex Drop Shaft		205.07		Peak Flow / # drop shaft
Diameter (In)		96		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-		75' per drop shaft
Average Depth (Ft)		20		Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**	**$ 89,302,000**	Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters				
Air Changes / Hour (ACH)		3		Ref: Technical Parameters
Volume of Ventilated Space (CF)		13,086,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)		654,300		= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**14,733,000**		
5. Screening Parameters				
Screening Required (Yes = 1; No = 2)		1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		52.20		Ref: CSO Statistics
Construction Cost (Screening)	**$**	**2,829,000**		
6. Stored Volume Treatment				
Volume Requiring Treatment (MG)		52.20		Peak Volume (MG)
Dewatering Time (Days)		2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		26.10		= Peak Vol/DW Time
Construction Cost	**$**	**20,726,564**		
7. Regulator Parameters				
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators		19		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**24,415,000**		
8. Land Acquisition Parameters				
Land Required - Drop Shafts (SF)		47,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)		13,050		250 SF / MGD
Land Required - Odor Control (SF)		32,715		500 SF / 10,000 CFM
Land Required - Screening (SF)		13,050		250 SF / MGD
Land Required - Regulator (SF)		190,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*296,000*		
Land Required Cost (/ SF)	$	2		Ref: Technical Parameters
Land Acquisition Cost	**$**	**592,000**		
		SUBTOTAL CAPITAL COST	**$**	**246,542,564**

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	135	
Peak Volume	8,082,724	CF
	60.46	MG
Total Volume	198,243,270	CF
	1482.86	MG
Peak Rate	1,755.54	CFS
	1134.56	MGD

CONSOLIDATION SEWERS - Total		
135 Overflows / Year		
SUBTOTAL CAPITAL COST	$	90,180,000

TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40 and M-34)				
135 Overflows / Year				
1. Tunnel Parameters				
Tunnel Type (1=Rock; 2=Soft Ground)		1	Rock	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		60.46	8,083,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)		75.57	10,104,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		21		Input by Engineer
Tunnel Volume / Ft length (CF)		354.48		Ref: Tunnel diameter
Tunnel Length (Ft)		28,504		= Req'd Fac Vol / Vol per Ft Length; Target length is 28,700 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		14	14	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MGD)		11	4	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**185,117,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters				
Volume Requiring Pumping (%)		100%		Ref: Technical Parameters
Dewatering Time (Days)		1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		60.46	93.55	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		53		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		6.1	Check:	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		150		Input by Engineer
Construction Cost (PS / Force Main)	**$**	**15,618,000**	**$ 95,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)				
Peak Flow (CFS) per Vortex Drop Shaft		125.40		Peak Flow / # drop shaft
Diameter (In)		78		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-		75' per drop shaft
Average Depth (Ft)		20		Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**	**$ 90,180,000**	Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters				
Air Changes / Hour (ACH)		3		Ref: Technical Parameters
Volume of Ventilated Space (CF)		15,156,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)		757,800		= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**16,531,000**		
5. Screening Parameters				
Screening Required (Yes = 1; No = 2)		1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		60.46		Ref: CSO Statistics
Construction Cost (Screening)	**$**	**3,212,000**		
6. Stored Volume Treatment				
Volume Requiring Treatment (MG)		60.46		Peak Volume (MG)
Dewatering Time (Days)		2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		30.23		= Peak Vol/DW Time
Construction Cost	**$**	**22,750,854**		
7. Regulator Parameters				
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2	Auto Regulator	New Reg w/ Vortex, Rev as Req'd
Number Regulators		29		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**37,265,000**		
8. Land Acquisition Parameters				
Land Required - Drop Shafts (SF)		72,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)		15,115		250 SF / MGD
Land Required - Odor Control (SF)		37,890		500 SF / 10,000 CFM
Land Required - Screening (SF)		15,115		250 SF / MGD
Land Required - Regulator (SF)		290,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*431,000*		
Land Required Cost (/ SF)	$	2		Ref: Technical Parameters
Land Acquisition Cost	**$**	**862,000**		
		SUBTOTAL CAPITAL COST	**$**	**281,450,854**

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	135	
Peak Volume	8,082,724	CF
	60.46	MG
Total Volume	198,243,270	CF
	1482.86	MG
Peak Rate	1,755.54	CFS
	1134.56	MGD

RIVER CROSSING #1 - Microtunnel - N/A					
135 Overflows / Year					
Peak Flow (CFS) - N/A		35.95		35.95	Ref: Technical Parameters
Diameter (In)		48		48	Ref: Technical Parameters
Length - Open Cut (Ft)		-		-	Input by Engineer
Depth - Open Cut (Ft)		-		-	Input by Engineer
Length - Microtunnel (Ft)		1,300		-	Input by Engineer
No. of Interceptor Connections Req'd		1		-	Input by Engineer
Construction Cost (Interceptor Connections)	**$**	**115,000**	**$**	**-**	Ref: Cost Curves
Construction Cost (Open Cut)	**$**	**-**	**$**	**-**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$**	**2,238,000**	**$**	**-**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST		**$**	**2,353,000**

RIVER CROSSING #2 - Microtunnel - N/A					
135 Overflows / Year					
Peak Flow (CFS) - N/A		-		-	Ref: Technical Parameters
Diameter (In)		36		36	Ref: Technical Parameters
Length - Open Cut (Ft)		-		-	Input by Engineer
Depth - Open Cut (Ft)		-		-	Input by Engineer
Length - Microtunnel (Ft)		-		-	Input by Engineer
No. of Interceptor Connections Req'd		-		-	Input by Engineer
Construction Cost (Interceptor Connections)	**$**	**-**	**$**	**-**	Ref: Cost Curves
Construction Cost (Open Cut)	**$**	**-**	**$**	**-**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$**	**-**	**$**	**-**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST		**$**	**-**

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	137	
Peak Volume	8,907,458	CF
	66.63	MG
Total Volume	217,478,786	CF
	1626.74	MG
Peak Rate	1,756.12	CFS
	1134.93	MGD

CONSOLIDATION SEWERS - Total		
137 Overflows / Year		
SUBTOTAL CAPITAL COST	$	105,724,000

TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40, M-34 and M-42)					
137 Overflows / Year					
1. Tunnel Parameters					
Tunnel Type (1=Rock; 2=Soft Ground)		1		Rock	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		66.63		8,907,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%			Ref: Technical Parameters
Required Facility Volume (MG / CF)		83.28		11,134,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		21			Input by Engineer
Tunnel Volume / Ft length (CF)		346.19			Ref: Tunnel diameter
Tunnel Length (Ft)		32,162			= Req'd Fac Vol / Vol per Ft Length; Target length is 31,200 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000			Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		16		16	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MGD)		11		3	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**198,101,000**			OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters					
Volume Requiring Pumping (%)		100%			Ref: Technical Parameters
Dewatering Time (Days)		1			Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		66.63		103.10	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		56			DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		6.0		Check:	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		150			Input by Engineer
Construction Cost (PS / Force Main)	**$**	**17,220,000**	**$**	**100,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)					
Peak Flow (CFS) per Vortex Drop Shaft		109.76			Peak Flow / # drop shaft
Diameter (In)		78			<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-			75' per drop shaft
Average Depth (Ft)		20			Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**	**$**	**105,724,000**	Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters					
Air Changes / Hour (ACH)		3			Ref: Technical Parameters
Volume of Ventilated Space (CF)		16,701,000			= 1.5 x Volume
Odor Control Flow Rate (CFM)		835,050			= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**17,837,000**			
5. Screening Parameters					
Screening Required (Yes = 1; No = 2)		1			Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		66.63			Ref: CSO Statistics
Construction Cost (Screening)	**$**	**3,497,000**			
6. Stored Volume Treatment					
Volume Requiring Treatment (MG)		66.63			Peak Volume (MG)
Dewatering Time (Days)		2			Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		33.31			= Peak Vol/DW Time
Construction Cost	**$**	**24,264,734**			
7. Regulator Parameters					
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2		Auto Regulator	New Reg w/ Vortex, Rev as Req'd
Number Regulators		30			Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**38,550,000**			
8. Land Acquisition Parameters					
Land Required - Drop Shafts (SF)		75,000			2,500 SF / Shaft
Land Required - Dewatering PS (SF)		16,657			250 SF / MGD
Land Required - Odor Control (SF)		41,753			500 SF / 10,000 CFM
Land Required - Screening (SF)		16,657			250 SF / MGD
Land Required - Regulator (SF)		300,000			Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*450,000*			
Land Required Cost (/ SF)	$	2			Ref: Technical Parameters
Land Acquisition Cost	**$**	**900,000**			
SUBTOTAL CAPITAL COST			**$**	**300,469,734**	

RESULTS SUMMARY			
Number of Events / Year	4		
Number of Overflows / Year	137		
Peak Volume	8,907,458	CF	
	66.63	MG	
Total Volume	217,478,786	CF	
	1626.74	MG	
Peak Rate	1,756.12	CFS	
	1134.93	MGD	

RIVER CROSSING #1 - Microtunnel - N/A			
137 Overflows / Year			
Peak Flow (CFS) - N/A	35.95	35.95	Ref: Technical Parameters
Diameter (In)	48	48	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	1,300	-	Input by Engineer
No. of Interceptor Connections Req'd	1	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ 115,000**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ 2,238,000**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ 2,353,000**

RIVER CROSSING #2 - Microtunnel - N/A			
137 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	137	
Peak Volume	10,228,695	CF
	76.51	MG
Total Volume	240,862,894	CF
	1801.65	MG
Peak Rate	1,756.12	CFS
	1134.93	MGD

CONSOLIDATION SEWERS - Total		
137 Overflows / Year		
SUBTOTAL CAPITAL COST	$	105,724,000

TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40, M-34, M-42 and M-47)				
137 Overflows / Year				
1. Tunnel Parameters				
Tunnel Type (1=Rock; 2=Soft Ground)		1	Rock	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		76.51	10,229,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)		95.64	12,786,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		20		Input by Engineer
Tunnel Volume / Ft length (CF)		321.90		Ref: Tunnel diameter
Tunnel Length (Ft)		39,721		= Req'd Fac Vol / Vol per Ft Length; Target length is 39,900 ft
Drop Shaft Spacing - Default Value = 1,000 ft		2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		20	20	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MGD)		11	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**216,498,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters				
Volume Requiring Pumping (%)		100%		Ref: Technical Parameters
Dewatering Time (Days)		1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		76.51	118.39	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		60		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		6.0	Check:	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		150		Input by Engineer
Construction Cost (PS / Force Main)	**$**	**19,787,000**	**$ 108,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)				
Peak Flow (CFS) per Vortex Drop Shaft		87.81		Peak Flow / # drop shaft
Diameter (In)		66		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-		75' per drop shaft
Average Depth (Ft)		20		Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**	**$ 105,724,000**	Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters				
Air Changes / Hour (ACH)		3		Ref: Technical Parameters
Volume of Ventilated Space (CF)		19,179,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)		958,950		= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**19,880,000**		
5. Screening Parameters				
Screening Required (Yes = 1; No = 2)		1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		76.51		Ref: CSO Statistics
Construction Cost (Screening)	**$**	**3,955,000**		
6. Stored Volume Treatment				
Volume Requiring Treatment (MG)		76.51		Peak Volume (MG)
Dewatering Time (Days)		2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		38.26		= Peak Vol/DW Time
Construction Cost	**$**	**26,693,373**		
7. Regulator Parameters				
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2	Auto Regulator	New Reg w/ Vortex, Rev as Req'd
Number Regulators		31		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**39,835,000**		
8. Land Acquisition Parameters				
Land Required - Drop Shafts (SF)		77,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)		19,128		250 SF / MGD
Land Required - Odor Control (SF)		47,948		500 SF / 10,000 CFM
Land Required - Screening (SF)		19,128		250 SF / MGD
Land Required - Regulator (SF)		310,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*474,000*		
Land Required Cost (/ SF)	$	2		Ref: Technical Parameters
Land Acquisition Cost	**$**	**948,000**		
SUBTOTAL CAPITAL COST			**$**	**327,704,373**

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	137	
Peak Volume	10,228,695	CF
	76.51	MG
Total Volume	240,862,894	CF
	1801.65	MG
Peak Rate	1,756.12	CFS
	1134.93	MGD

RIVER CROSSING #1 - Microtunnel - N/A			
137 Overflows / Year			
Peak Flow (CFS) - N/A	35.95	35.95	Ref: Technical Parameters
Diameter (In)	48	48	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	1,300	-	Input by Engineer
No. of Interceptor Connections Req'd	1	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ 115,000**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ 2,238,000**	**$ -**	Ref: Cost Curves
	SUBTOTAL CAPITAL COST	**$**	**2,353,000**

RIVER CROSSING #2 - Microtunnel - N/A			
137 Overflows / Year			
Peak Flow (CFS) - N/A	45.42	45.42	Ref: Technical Parameters
Diameter (In)	48	48	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	2,360	-	Input by Engineer
No. of Interceptor Connections Req'd	1	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ 115,000**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ 4,063,000**	**$ -**	Ref: Cost Curves
	SUBTOTAL CAPITAL COST	**$**	**4,178,000**

RESULTS SUMMARY			
Number of Events / Year	4		
Number of Overflows / Year	135		
Peak Volume	7,815,003	CF	
	58.46	MG	
Total Volume	191,426,623	CF	
	1431.87	MG	
Peak Rate	1,640.53	CFS	
	1060.23	MGD	

CONSOLIDATION SEWERS - Total		
135 Overflows / Year		
SUBTOTAL CAPITAL COST	**$**	**89,302,000**

TUNNEL STORAGE (M-01 Outfalls w/ River Crossing)					
135 Overflows / Year					
1. Tunnel Parameters					
Tunnel Type (1=Rock; 2=Soft Ground)		1		**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		58.46		7,815,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%			Ref: Technical Parameters
Required Facility Volume (MG / CF)		73.07		9,769,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		22			Input by Engineer
Tunnel Volume / Ft length (CF)		371.35			Ref: Tunnel diameter
Tunnel Length (Ft)		26,306			= Req'd Fac Vol / Vol per Ft Length; Target length is 26,500 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000			Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		13		13	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MGD)		5		2	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**168,511,000**			OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters					
Volume Requiring Pumping (%)		100%			Ref: Technical Parameters
Dewatering Time (Days)		1			Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		58.46		90.45	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		53			DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		5.9		**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		150			Input by Engineer
Construction Cost (PS / Force Main)	**$**	**15,099,000**	**$**	**95,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)					
Peak Flow (CFS) per Vortex Drop Shaft		126.19			Peak Flow / # drop shaft
Diameter (In)		78			<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-			75' per drop shaft
Average Depth (Ft)		20			Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**	**$**	**89,302,000**	Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters					
Air Changes / Hour (ACH)		3			Ref: Technical Parameters
Volume of Ventilated Space (CF)		14,654,000			= 1.5 x Volume
Odor Control Flow Rate (CFM)		732,700			= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**16,100,000**			
5. Screening Parameters					
Screening Required (Yes = 1; No = 2)		1			Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		58.46			Ref: CSO Statistics
Construction Cost (Screening)	**$**	**3,119,000**			
6. Stored Volume Treatment					
Volume Requiring Treatment (MG)		58.46			Peak Volume (MG)
Dewatering Time (Days)		2			Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		29.23			= Peak Vol/DW Time
Construction Cost	**$**	**22,259,775**			
7. Regulator Parameters					
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2		**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators		20			Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**25,700,000**			
8. Land Acquisition Parameters					
Land Required - Drop Shafts (SF)		50,000			2,500 SF / Shaft
Land Required - Dewatering PS (SF)		14,614			250 SF / MGD
Land Required - Odor Control (SF)		36,635			500 SF / 10,000 CFM
Land Required - Screening (SF)		14,614			250 SF / MGD
Land Required - Regulator (SF)		200,000			Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*316,000*			
Land Required Cost (/ SF)	$	2			Ref: Technical Parameters
Land Acquisition Cost	**$**	**632,000**			
SUBTOTAL CAPITAL COST			**$**	**251,515,775**	

System Wide Alternative MO-1 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (O-25 thru O-27, O-29 thru O-43, M-1 thru M-5, M-6 thru M-8, M-9 thru M-17, M-19)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	34.19	$199,034	20	10.910	$2,171,448
	Tunnel Maintenance	Length (ft)	12637	$4,044	50	14.484	$58,570
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	18	$204,297	50	14.484	$2,958,954
	Screening O&M	Flow Rate (MGD)	34.19	$10,484	20	10.910	$114,374
	Odor Control O&M	Capacity (CFM)	428,550	$1,499,925	20	10.910	$16,364,091
	Reserve / Replace	10% Gravity / 15% Pump					$70,138
			Subtotal Annual O&M	**$1,918,000**		**Subtotal PW O&M**	**$21,738,000**

Subsystem Components	
Boundary Street (M-29) Annual O&M	$1,120,000
Hazelwood (M-31 thru M-40) Annual O&M	$450,000
Nine Mile Run (M-47) Annual O&M	$242,000
Upper Nine Mile Run (DC175) Annual O&M	$101,000
Nine Mile Run-Frick Park (128R002) Annual O&M	$103,000
Beck's Run (M-34) Annual O&M	$233,000
Street's Run (M-42) Annual O&M	$249,000
CSO 030N001 Annual O&M	$0
CSO 032N001 Annual O&M	$29,000
TOTAL ANNUAL O&M	**$4,445,000**
ANNUAL O&M ($MM)	**$4.45**

System Wide Alternative MO-2 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (M-01 Outfalls plus M-29)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	52.20	$264,035	20	10.910	$2,880,606
	Tunnel Maintenance	Length (ft)	15245	$4,878	50	14.484	$70,655
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	19	$207,314	50	14.484	$3,002,644
	Screening O&M	Flow Rate (MGD)	52.20	$12,260	20	10.910	$133,755
	Odor Control O&M	Capacity (CFM)	654,300	$2,290,050	20	10.910	$24,984,306
	Reserve / Replace	10% Gravity / 15% Pump					$102,751
			Subtotal Annual O&M	**$2,779,000**		**Subtotal PW O&M**	**$31,175,000**

Subsystem Components	
Boundary Street (M-29) Annual O&M	
Hazelwood (M-31 thru M-40) Annual O&M	$450,000
Nine Mile Run (M-47) Annual O&M	$242,000
Upper Nine Mile Run (DC175) Annual O&M	$101,000
Nine Mile Run-Frick Park (128R002) Annual O&M	$103,000
Beck's Run (M-34) Annual O&M	$233,000
Street's Run (M-42) Annual O&M	$249,000
CSO 030N001 Annual O&M	$0
CSO 032N001 Annual O&M	$29,000
TOTAL ANNUAL O&M	**$4,186,000**
ANNUAL O&M ($MM)	**$4.19**

System Wide Alternative MO-3 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40 and M-34)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	60.46	$291,260	20	10.910	$3,177,634
	Tunnel Maintenance	Length (ft)	28504	$9,121	50	14.484	$132,109
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	29	$237,479	50	14.484	$3,439,542
	Screening O&M	Flow Rate (MGD)	60.46	$13,114	20	10.910	$143,077
	Odor Control O&M	Capacity (CFM)	757,800	$2,652,300	20	10.910	$28,936,432
	Reserve / Replace	10% Gravity / 15% Pump					$117,422
			Subtotal Annual O&M	**$3,204,000**		**Subtotal PW O&M**	**$35,947,000**

Subsystem Components

Boundary Street (M-29) Annual O&M	
Hazelwood (M-31 thru M-40) Annual O&M	
Nine Mile Run (M-47) Annual O&M	$242,000
Upper Nine Mile Run (DC175) Annual O&M	$101,000
Nine Mile Run-Frick Park (128R002) Annual O&M	$103,000
Beck's Run (M-34) Annual O&M	
Street's Run (M-42) Annual O&M	$249,000
CSO 030N001 Annual O&M	$0
CSO 032N001 Annual O&M	$29,000
TOTAL ANNUAL O&M	**$3,928,000**
ANNUAL O&M ($MM)	**$3.93**

Operation and Maintenance Costs

System Wide Alternative MO-4 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40, M-34 and M-42)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	66.63	$310,794	20	10.910	$3,390,744
	Tunnel Maintenance	Length (ft)	32162	$10,292	50	14.484	$149,063
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	30	$240,495	50	14.484	$3,483,231
	Screening O&M	Flow Rate (MGD)	66.63	$13,769	20	10.910	$150,217
	Odor Control O&M	Capacity (CFM)	835,050	$2,922,675	20	10.910	$31,886,207
	Reserve / Replace	10% Gravity / 15% Pump					$128,286
			Subtotal Annual O&M	**$3,499,000**		**Subtotal PW O&M**	**$39,188,000**

Subsystem Components	
Boundary Street (M-29) Annual O&M	
Hazelwood (M-31 thru M-40) Annual O&M	
Nine Mile Run (M-47) Annual O&M	$242,000
Upper Nine Mile Run (DC175) Annual O&M	$101,000
Nine Mile Run-Frick Park (128R002) Annual O&M	$103,000
Beck's Run (M-34) Annual O&M	
Street's Run (M-42) Annual O&M	
CSO 030N001 Annual O&M	$0
CSO 032N001 Annual O&M	$29,000
TOTAL ANNUAL O&M	**$3,974,000**
ANNUAL O&M ($MM)	**$3.97**

Operation and Maintenance Costs

System Wide Alternative MO-5 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (M-01 Outfalls plus M-29, M-31 thru M-40, M-34, M-42 and M-47)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	76.51	$340,881	20	10.910	$3,718,993
	Tunnel Maintenance	Length (ft)	39721	$12,711	50	14.484	$184,095
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	31	$243,512	50	14.484	$3,526,921
	Screening O&M	Flow Rate (MGD)	76.51	$14,846	20	10.910	$161,972
	Odor Control O&M	Capacity (CFM)	958,950	$3,356,325	20	10.910	$36,617,302
	Reserve / Replace	10% Gravity / 15% Pump					$145,562
			Subtotal Annual O&M	**$3,969,000**		**Subtotal PW O&M**	**$44,355,000**

Subsystem Components

Boundary Street (M-29) Annual O&M	
Hazelwood (M-31 thru M-40) Annual O&M	
Nine Mile Run (M-47) Annual O&M	
Upper Nine Mile Run (DC175) Annual O&M	$101,000
Nine Mile Run-Frick Park (128R002) Annual O&M	$103,000
Beck's Run (M-34) Annual O&M	
Street's Run (M-42) Annual O&M	
CSO 030N001 Annual O&M	$0
CSO 032N001 Annual O&M	$29,000
TOTAL ANNUAL O&M	**$4,202,000**
ANNUAL O&M ($MM)	**$4.20**

Operation and Maintenance Costs

System Wide Alternative MO-6 Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
	Requirement	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Gravity Sewer	N/A	N/A	N/A	$0	70	14.925	$0
TUNNEL STORAGE (M-01 Outfalls w/ River Crossing)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	58.46	$284,779	20	10.910	$3,106,923
	Tunnel Maintenance	Length (ft)	26306	$8,418	50	14.484	$121,924
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	20	$210,330	50	14.484	$3,046,334
	Screening O&M	Flow Rate (MGD)	58.46	$12,905	20	10.910	$140,792
	Odor Control O&M	Capacity (CFM)	732,700	$2,564,450	20	10.910	$27,977,994
	Reserve / Replace	10% Gravity / 15% Pump					$113,880
			Subtotal Annual O&M	**$3,081,000**		**Subtotal PW O&M**	**$34,508,000**

Subsystem Components

Boundary Street (M-29) Annual O&M	
Hazelwood (M-31 thru M-40) Annual O&M	$450,000
Nine Mile Run (M-47) Annual O&M	
Upper Nine Mile Run (DC175) Annual O&M	$101,000
Nine Mile Run-Frick Park (128R002) Annual O&M	$103,000
Beck's Run (M-34) Annual O&M	$233,000
Street's Run (M-42) Annual O&M	$249,000
CSO 030N001 Annual O&M	$0
CSO 032N001 Annual O&M	$29,000
TOTAL ANNUAL O&M	**$4,246,000**
ANNUAL O&M ($MM)	**$4.25**

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-1	**Results Summary**	
Structures within Region	O-25 - O-43 & M-01 - M-47	Number of Events:	134
Model ID	MO-1.1	Peak Volume:	17,783,348 ft^3
Structure Type			133.03 MG
PWSA Sewershed		Total Volume:	97,996,239 ft^3
Stream of Discharge			733.06 MG
NPDES Permit Number		Peak Rate:	2980.26 cfs
Owner			
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2		
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection		

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	**Exceedance Duration (minutes)**	**Time of Peak Flow**	**(ft^3)**	**(1,000 gallons)**	**Number of Exceedances**	**(cfs)**	**Number of Exceedances**
1/5/2005 0:41	5179	1/5/2005 14:45	17783348.21	133028.336	**0**	412.52	12
7/12/2005 18:50	165	7/12/2005 20:00	6155527.86	46046.426	**1**	2980.26	**0**
1/9/2005 11:01	3907	1/12/2005 1:30	5184941.24	38785.953	**2**	389.47	14
7/5/2005 16:15	173	7/5/2005 16:35	5101849.55	38164.386	**3**	2291.92	**1**
5/13/2005 22:30	1645	5/13/2005 22:45	4571493.36	34197.056	**4**	988.39	6
8/20/2005 18:06	186	8/20/2005 19:00	4566356.62	34158.631	**5**	1910.54	**3**
2/14/2005 3:31	2253	2/14/2005 10:00	4307259.21	32220.453	6	151.44	36
11/29/2005 1:51	949	11/29/2005 11:15	4123643.12	30846.912	7	361.47	17
10/24/2005 1:55	3551	10/25/2005 3:45	3542726.59	26501.366	8	189.64	33
1/3/2005 3:20	1663	1/3/2005 14:00	3191407.94	23873.327	9	205.69	31
11/14/2005 21:30	614	11/15/2005 4:00	3156359.41	23611.147	10	371.31	15
3/28/2005 7:30	1049	3/28/2005 19:00	3026031.27	22636.227	11	272.45	22
4/1/2005 18:31	2714	4/2/2005 6:35	2511043.74	18783.863	12	268.73	23
9/29/2005 5:00	145	9/29/2005 5:45	2470412.06	18479.917	13	2112.59	**2**
1/12/2005 23:03	2457	1/14/2005 2:15	2395307.84	17918.100	14	249.70	27
4/22/2005 14:46	4071	4/23/2005 4:15	2172845.09	16253.968	15	950.60	7
6/11/2005 17:30	98	6/11/2005 18:00	2051771.18	15348.274	16	1153.16	**5**
7/26/2005 19:38	182	7/26/2005 20:00	1873154.42	14012.132	17	1587.16	**4**
10/21/2005 18:46	1441	10/22/2005 6:45	1505681.71	11263.252	18	366.98	16
5/11/2005 22:30	158	5/11/2005 23:00	1410029.76	10547.728	19	531.51	11
3/23/2005 1:17	2042	3/24/2005 9:50	1348213.91	10085.314	20	311.32	20
7/15/2005 17:15	124	7/15/2005 18:05	1341123.59	10032.275	21	824.91	8
8/29/2005 8:37	451	8/29/2005 13:45	1207379.03	9031.799	22	752.85	9
2/20/2005 14:15	2685	2/20/2005 20:05	1023195.59	7654.015	23	259.57	26
5/28/2005 7:46	715	5/28/2005 9:30	993210.54	7429.711	24	278.03	21
12/15/2005 7:39	1143	12/15/2005 14:00	982663.65	7350.815	25	235.31	28
2/9/2005 6:01	1004	2/9/2005 16:45	950010.46	7106.553	26	352.94	18
11/9/2005 19:15	88	11/9/2005 19:35	694943.48	5198.525	27	582.08	10
10/7/2005 7:00	652	10/7/2005 10:45	673203.12	5035.896	28	213.34	30
11/16/2005 4:00	510	11/16/2005 4:15	547291.19	4094.012	29	268.72	24
5/23/2005 10:32	433	5/23/2005 16:35	500524.86	3744.176	30	389.87	13
8/8/2005 8:26	138	8/8/2005 9:15	456804.81	3417.128	31	216.69	29
7/25/2005 13:05	348	7/25/2005 13:30	378862.99	2834.085	32	342.38	19

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
7/17/2005 15:51	125	7/17/2005 16:35	364288.30	2725.059	33	169.71	34
11/1/2005 14:31	249	11/1/2005 16:30	342590.30	2562.747	34	104.81	39
2/16/2005 5:30	981	2/16/2005 8:15	341717.31	2556.216	35	83.76	42
7/16/2005 9:26	324	7/16/2005 11:35	323890.56	2422.863	36	194.21	32
8/27/2005 15:15	148	8/27/2005 15:30	298556.85	2233.355	37	261.06	25
3/27/2005 16:06	372	3/27/2005 18:00	292131.09	2185.287	38	72.84	45
1/15/2005 10:04	3298	1/15/2005 14:45	263232.27	1969.109	39	5.49	76
3/30/2005 1:02	1766	3/30/2005 18:25	244858.21	1831.662	40	5.10	77
9/26/2005 5:08	720	9/26/2005 5:50	233838.76	1749.231	41	72.86	44
5/19/2005 19:23	999	5/20/2005 6:30	221190.03	1654.612	42	51.90	53
6/3/2005 5:51	302	6/3/2005 9:15	186525.59	1395.305	43	103.42	40
1/25/2005 17:23	1056	1/26/2005 5:05	182068.67	1361.965	44	47.69	54
4/20/2005 18:30	366	4/20/2005 19:45	168607.92	1261.272	45	72.52	46
6/14/2005 18:45	101	6/14/2005 19:15	160944.22	1203.943	46	74.08	43
9/16/2005 21:15	71	9/16/2005 21:45	160564.66	1201.104	47	151.65	35
11/9/2005 4:15	110	11/9/2005 4:30	156235.21	1168.717	48	141.53	38
12/25/2005 10:07	266	12/25/2005 13:00	148366.11	1109.853	49	31.65	55
12/9/2005 3:07	274	12/9/2005 4:15	136651.79	1022.224	50	72.01	47
11/6/2005 9:50	294	11/6/2005 10:00	126784.59	948.412	51	147.41	37
11/8/2005 10:33	396	11/8/2005 15:15	117013.28	875.318	52	71.96	48
11/30/2005 19:04	1526	12/1/2005 7:35	112768.38	843.564	53	3.90	80
1/30/2005 10:52	240	1/30/2005 13:00	103763.37	776.202	54	59.13	50
7/21/2005 14:25	59	7/21/2005 14:45	100192.79	749.492	55	85.05	41
10/20/2005 22:53	606	10/21/2005 7:35	88586.82	662.674	56	59.02	51
4/30/2005 4:15	395	4/30/2005 6:50	84772.62	634.142	57	19.53	60
5/7/2005 11:33	161	5/7/2005 13:30	75802.84	567.043	58	62.15	49
4/26/2005 19:37	450	4/27/2005 0:55	71001.85	531.129	59	26.23	57
6/16/2005 11:00	377	6/16/2005 11:35	55827.66	417.619	60	27.82	56
8/26/2005 18:08	571	8/26/2005 21:20	47213.45	353.180	61	25.59	58
3/19/2005 22:51	1290	3/20/2005 7:45	46324.31	346.529	62	11.46	64
6/10/2005 21:20	62	6/10/2005 21:35	45538.83	340.653	63	55.13	52
3/12/2005 10:02	436	3/12/2005 11:05	45091.59	337.308	64	15.32	61
3/7/2005 21:15	533	3/8/2005 0:30	41874.51	313.242	65	3.72	82
2/25/2005 5:03	1051	2/25/2005 13:45	41352.61	309.338	66	7.66	71
12/26/2005 1:23	766	12/26/2005 6:15	38176.96	285.583	67	4.35	78
3/11/2005 7:31	768	3/11/2005 8:30	37743.64	282.341	68	10.22	66
6/17/2005 0:36	141	6/17/2005 1:35	35402.09	264.825	69	23.90	59
11/24/2005 7:52	345	11/24/2005 9:30	31835.26	238.144	70	8.02	69
8/16/2005 5:06	213	8/16/2005 8:05	23710.54	177.367	71	7.75	70
11/23/2005 17:38	289	11/23/2005 20:15	20283.77	151.733	72	9.95	68
6/28/2005 18:10	69	6/28/2005 18:15	18429.38	137.861	73	14.78	63
5/24/2005 20:52	116	5/24/2005 21:35	15142.59	113.274	74	10.94	65
9/23/2005 2:45	51	9/23/2005 3:05	14102.49	105.494	75	15.30	62
2/8/2005 1:47	831	2/8/2005 12:30	13610.17	101.811	76	2.85	83
7/18/2005 18:30	46	7/18/2005 19:00	13340.67	99.795	77	10.17	67
6/8/2005 21:00	68	6/8/2005 21:20	11898.61	89.008	78	5.72	74
12/11/2005 11:24	420	12/11/2005 15:45	10821.27	80.948	79	2.71	84
8/5/2005 10:47	82	8/5/2005 11:30	10157.65	75.984	80	3.89	81
5/21/2005 14:22	74	5/21/2005 15:00	8270.90	61.870	81	6.07	72
2/24/2005 10:20	658	2/24/2005 20:35	7087.57	53.019	82	0.32	107
3/1/2005 0:09	684	3/1/2005 10:15	5668.45	42.403	83	0.26	112
2/26/2005 8:47	429	2/26/2005 12:45	5149.21	38.519	84	0.88	89
10/28/2005 11:57	56	10/28/2005 12:30	4751.84	35.546	85	5.67	75
6/6/2005 9:45	250	6/6/2005 13:50	4512.14	33.753	86	5.80	73
1/18/2005 0:01	328	1/18/2005 0:05	4396.53	32.888	87	0.48	97

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
11/14/2005 0:00	29	11/14/2005 0:15	3210.89	24.019	88	4.24	79
9/16/2005 8:56	47	9/16/2005 9:10	3055.65	22.858	89	2.59	85
2/17/2005 14:46	317	2/17/2005 17:00	2960.29	22.144	90	0.16	121
2/22/2005 17:17	237	2/22/2005 21:00	2562.39	19.168	91	0.67	90
3/14/2005 6:03	273	3/14/2005 10:30	2315.07	17.318	92	0.24	115
3/4/2005 13:16	58	3/4/2005 14:05	1702.70	12.737	93	1.21	86
4/28/2005 18:18	211	4/28/2005 18:30	1445.94	10.816	94	0.32	108
5/24/2005 6:09	363	5/24/2005 12:05	1320.21	9.876	95	0.65	91
3/25/2005 11:32	92	3/25/2005 12:15	1315.98	9.844	96	0.54	94
2/3/2005 15:18	126	2/3/2005 17:15	1276.06	9.546	97	0.40	99
6/22/2005 5:06	28	6/22/2005 5:30	1076.94	8.056	98	0.95	88
7/18/2005 7:56	22	7/18/2005 8:05	872.81	6.529	99	1.05	87
2/18/2005 5:45	74	2/18/2005 6:05	680.60	5.091	100	0.16	123
3/22/2005 6:00	60	3/22/2005 6:05	559.62	4.186	101	0.16	122
5/22/2005 20:04	28	5/22/2005 20:15	545.38	4.080	102	0.43	98
1/22/2005 11:21	26	1/22/2005 11:25	535.64	4.007	103	0.52	96
5/27/2005 20:46	19	5/27/2005 21:00	484.23	3.622	104	0.57	93
2/19/2005 10:10	51	2/19/2005 11:00	464.58	3.475	105	0.15	131
12/16/2005 14:31	19	12/16/2005 14:45	439.40	3.287	106	0.52	95
3/9/2005 7:04	44	3/9/2005 7:05	432.94	3.239	107	0.18	118
3/5/2005 11:00	25	3/5/2005 11:15	423.13	3.165	108	0.40	100
2/1/2005 5:51	44	2/1/2005 6:05	399.12	2.986	109	0.15	124
11/23/2005 0:06	13	11/23/2005 0:15	380.84	2.849	110	0.64	92
3/3/2005 13:01	22	3/3/2005 13:15	365.92	2.737	111	0.37	102
3/7/2005 13:16	22	3/7/2005 13:30	353.52	2.645	112	0.35	104
2/4/2005 6:00	32	2/4/2005 6:05	289.11	2.163	113	0.15	125
4/29/2005 6:02	19	4/29/2005 6:15	286.28	2.142	114	0.33	105
12/4/2005 14:17	29	12/4/2005 14:45	280.82	2.101	115	0.17	120
4/27/2005 14:18	18	4/27/2005 14:30	275.27	2.059	116	0.32	106
5/23/2005 3:22	16	5/23/2005 3:30	268.09	2.005	117	0.37	103
11/13/2005 15:04	26	11/13/2005 15:15	263.82	1.973	118	0.20	117
3/17/2005 6:01	26	3/17/2005 6:05	236.63	1.770	119	0.15	126
3/2/2005 15:33	19	3/2/2005 15:45	223.68	1.673	120	0.24	114
12/29/2005 9:52	12	12/29/2005 10:00	219.71	1.644	121	0.38	101
11/27/2005 6:37	13	11/27/2005 6:45	196.49	1.470	122	0.30	109
3/16/2005 6:02	21	3/16/2005 6:05	188.51	1.410	123	0.15	127
5/2/2005 4:22	11	5/2/2005 4:30	157.29	1.177	124	0.29	110
7/19/2005 5:38	11	7/19/2005 5:45	144.58	1.082	125	0.27	111
3/21/2005 5:49	15	3/21/2005 6:00	138.85	1.039	126	0.15	128
3/15/2005 6:03	14	3/15/2005 6:05	124.53	0.932	127	0.15	130
11/27/2005 17:08	8	11/27/2005 17:15	103.27	0.772	128	0.24	113
2/28/2005 6:01	9	2/28/2005 6:05	84.96	0.636	129	0.15	132
12/28/2005 15:24	7	12/28/2005 15:30	80.14	0.599	130	0.20	116
3/18/2005 5:52	9	3/18/2005 6:00	79.91	0.598	131	0.15	129
1/29/2005 22:38	7	1/29/2005 22:45	74.15	0.555	132	0.18	119
2/2/2005 6:03	7	2/2/2005 6:05	66.33	0.496	133	0.15	133

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-1
Structures within Region	O-25 - O-43 & M-01 - M-47
Model ID	MO-1.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events	134
Peak Volume:	17,783,348 ft^3
	133.03 MG
Total Volume:	97,996,239 ft^3
	733.06 MG
Peak Rate:	2980.26 cfs

Figure 1 - MO-1 Region CSO Volume

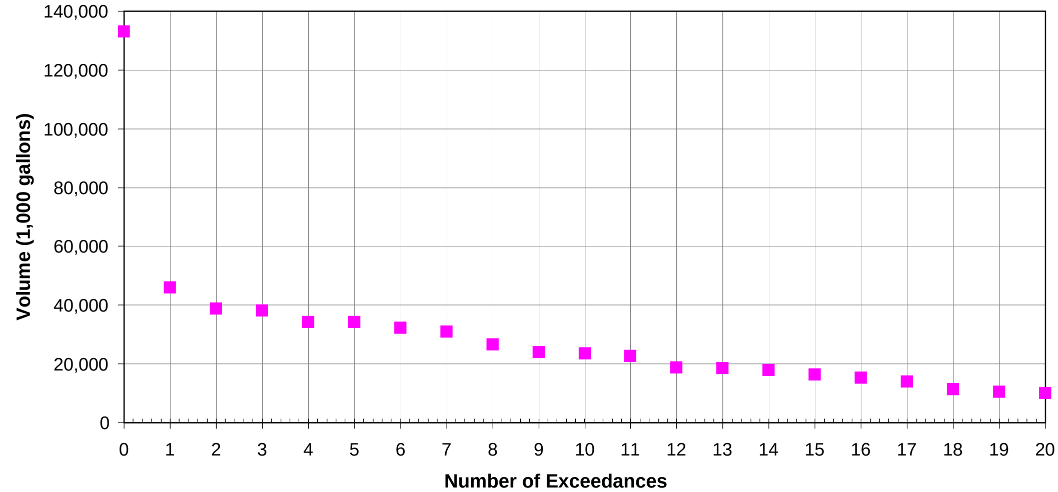
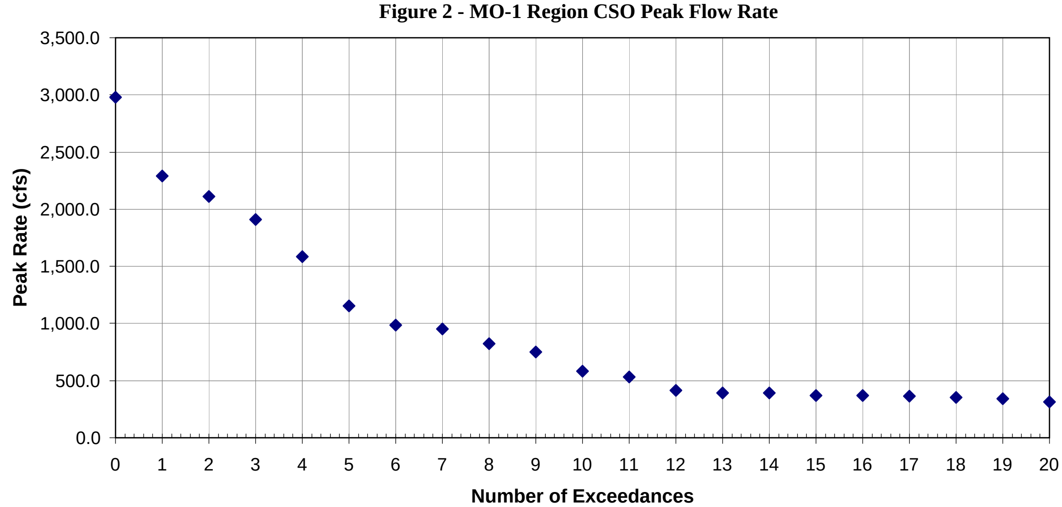


Figure 2 - MO-1 Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-2a
Structures within Region	O-25 - O-43 & M-01 - M-42
Model ID	MO-2a.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	134
Peak Volume:	36,349,086 ft^3
	271.91 MG
Total Volume:	168,155,903 ft^3
	1257.89 MG
Peak Rate:	2980.26 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/5/2005 0:40	5601	1/5/2005 14:50	36349085.92	271909.337	0	665.55	12
1/10/2005 6:52	3274	1/12/2005 1:30	10404830.32	77833.333	1	641.24	13
2/14/2005 3:31	2253	2/14/2005 20:00	8257988.48	61773.883	2	237.04	34
11/29/2005 1:51	949	11/29/2005 7:30	7064017.60	52842.384	3	551.45	16
5/13/2005 22:30	1645	5/13/2005 22:45	6978546.23	52203.015	4	1066.04	7
10/24/2005 1:55	3551	10/25/2005 3:50	6855411.63	51281.907	5	275.78	31
7/5/2005 16:15	175	7/5/2005 16:35	6436143.47	48145.571	6	2291.92	3
7/12/2005 18:50	165	7/12/2005 20:00	6155527.86	46046.426	7	2980.26	0
8/20/2005 18:06	186	8/20/2005 19:00	6065634.66	45373.980	8	2368.01	2
1/3/2005 3:20	1836	1/3/2005 14:00	5847259.78	43740.427	9	313.28	29
3/28/2005 7:30	1410	3/28/2005 19:00	5801224.13	43396.057	10	413.10	21
4/1/2005 18:31	2825	4/2/2005 6:35	5311901.30	39735.678	11	442.62	18
11/14/2005 21:30	650	11/14/2005 23:05	4862301.52	36372.446	12	531.31	17
1/12/2005 21:04	2724	1/14/2005 2:15	4368551.53	32678.950	13	342.44	25
4/22/2005 14:46	4071	4/23/2005 4:15	3308984.11	24752.856	14	1211.89	6
9/29/2005 5:00	152	9/29/2005 5:45	3299404.64	24681.196	15	2507.60	1
6/11/2005 17:30	135	6/11/2005 18:00	3093624.49	23141.858	16	1605.68	5
10/21/2005 18:46	1452	10/22/2005 6:45	3032573.36	22685.165	17	558.84	15
7/26/2005 19:38	182	7/26/2005 20:00	2747835.38	20555.183	18	1640.53	4
3/23/2005 1:17	2042	3/24/2005 9:50	2342029.37	17519.551	19	311.32	30
5/11/2005 22:30	165	5/11/2005 23:00	2318230.96	17341.527	20	877.97	9
12/15/2005 7:39	1143	12/15/2005 14:00	2058680.83	15399.962	21	316.23	28
5/28/2005 7:46	722	5/28/2005 9:30	1927348.69	14417.532	22	431.93	19
2/20/2005 14:15	2685	2/20/2005 20:05	1924342.66	14395.045	23	349.86	24
8/8/2005 8:26	210	8/8/2005 9:15	1817069.65	13592.590	24	603.46	14
2/9/2005 6:01	1004	2/9/2005 16:45	1596997.07	11946.337	25	430.05	20
7/15/2005 17:15	124	7/15/2005 18:05	1594303.02	11926.184	26	941.82	8
8/29/2005 8:37	475	8/29/2005 13:45	1582842.77	11840.455	27	766.21	11
11/9/2005 19:15	99	11/9/2005 19:45	1336950.93	10001.061	28	828.39	10
10/7/2005 7:00	652	10/7/2005 10:50	1298918.15	9716.557	29	331.12	27
11/16/2005 4:00	546	11/16/2005 4:15	1195721.75	8944.597	30	268.72	32
7/16/2005 9:26	353	7/16/2005 12:00	1056535.17	7903.411	31	375.67	23
2/16/2005 5:30	981	2/16/2005 8:15	821228.34	6143.199	32	154.84	39

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
11/1/2005 14:31	272	11/1/2005 16:30	695814.91	5205.043	33	174.66	36
9/26/2005 5:08	746	9/26/2005 6:25	693408.80	5187.045	34	94.33	44
5/23/2005 10:32	442	5/23/2005 16:35	679865.23	5085.732	35	389.87	22
3/27/2005 16:06	372	3/27/2005 18:00	569321.20	4258.807	36	137.10	43
7/17/2005 15:51	152	7/17/2005 16:35	536533.35	4013.538	37	169.71	37
8/27/2005 15:15	148	8/27/2005 15:30	504359.08	3772.858	38	261.06	33
6/3/2005 5:51	302	6/3/2005 9:20	492207.07	3681.955	39	158.37	38
6/14/2005 18:45	112	6/14/2005 19:30	431686.98	3229.234	40	221.92	35
7/25/2005 13:05	359	7/25/2005 13:30	417413.40	3122.461	41	342.38	26
12/25/2005 10:07	288	12/25/2005 13:10	327967.93	2453.364	42	76.86	48
5/19/2005 19:23	999	5/20/2005 6:45	327711.50	2451.446	43	58.97	54
4/20/2005 18:30	366	4/20/2005 19:55	313653.67	2346.286	44	79.63	47
1/25/2005 17:23	1056	1/26/2005 5:15	301622.52	2256.287	45	84.80	46
9/16/2005 21:15	79	9/16/2005 21:45	247573.12	1851.971	46	151.65	40
12/9/2005 3:07	274	12/9/2005 4:15	199094.72	1489.328	47	72.01	49
1/30/2005 10:52	240	1/30/2005 13:10	177824.48	1330.216	48	69.12	51
11/8/2005 10:33	396	11/8/2005 15:15	177555.68	1328.205	49	71.96	50
11/9/2005 4:15	110	11/9/2005 4:30	159990.26	1196.807	50	141.53	42
10/20/2005 22:53	606	10/21/2005 7:35	139466.95	1043.283	51	59.02	53
5/7/2005 11:33	167	5/7/2005 13:30	127695.76	955.228	52	62.15	52
11/6/2005 9:50	294	11/6/2005 10:00	126784.59	948.412	53	147.41	41
4/26/2005 19:37	450	4/27/2005 1:00	116937.20	874.749	54	45.34	56
1/16/2005 11:33	1768	1/16/2005 12:45	114243.57	854.599	55	3.47	83
4/30/2005 4:15	395	4/30/2005 6:05	106287.35	795.083	56	27.25	59
7/21/2005 14:25	59	7/21/2005 14:45	100192.79	749.492	57	85.05	45
12/1/2005 4:47	943	12/1/2005 7:35	86687.88	648.469	58	3.90	80
3/30/2005 17:58	751	3/30/2005 18:30	74239.91	555.352	59	5.10	76
11/24/2005 7:52	345	11/24/2005 9:45	64085.87	479.394	60	19.55	62
5/21/2005 14:22	88	5/21/2005 15:25	56232.91	420.650	61	43.38	57
6/16/2005 11:00	377	6/16/2005 11:35	55827.66	417.619	62	27.82	58
8/26/2005 18:08	571	8/26/2005 21:20	51822.57	387.659	63	25.59	60
3/12/2005 10:02	436	3/12/2005 11:05	47649.97	356.446	64	15.32	63
3/19/2005 22:51	1290	3/20/2005 7:45	46324.31	346.529	65	11.46	67
6/10/2005 21:20	62	6/10/2005 21:35	45538.83	340.653	66	55.13	55
3/7/2005 21:15	533	3/8/2005 0:30	41874.51	313.242	67	3.72	82
6/17/2005 0:36	141	6/17/2005 1:35	41572.98	310.987	68	23.90	61
2/25/2005 5:03	1051	2/25/2005 13:45	41352.61	309.338	69	7.66	72
12/26/2005 1:23	766	12/26/2005 6:15	38176.96	285.583	70	4.35	78
3/11/2005 7:31	768	3/11/2005 8:30	37743.64	282.341	71	10.22	69
8/16/2005 5:06	222	8/16/2005 8:30	34177.20	255.663	72	13.62	66
11/23/2005 17:38	289	11/23/2005 20:15	20283.77	151.733	73	9.95	71
6/28/2005 18:10	69	6/28/2005 18:15	18429.38	137.861	74	14.78	65
5/24/2005 20:52	116	5/24/2005 21:35	15142.59	113.274	75	10.94	68
9/23/2005 2:45	51	9/23/2005 3:05	14102.49	105.494	76	15.30	64
12/11/2005 11:24	420	12/11/2005 16:15	13843.81	103.559	77	4.65	77
2/8/2005 1:47	831	2/8/2005 12:30	13610.17	101.811	78	2.85	84
7/18/2005 18:30	46	7/18/2005 19:00	13340.67	99.795	79	10.17	70
6/8/2005 21:00	68	6/8/2005 21:20	11898.61	89.008	80	5.72	74
8/5/2005 10:47	82	8/5/2005 11:30	10157.65	75.984	81	3.89	81
2/24/2005 10:20	658	2/24/2005 20:35	7087.57	53.019	82	0.32	107
3/1/2005 0:09	684	3/1/2005 10:15	5668.45	42.403	83	0.26	112
2/26/2005 8:47	429	2/26/2005 12:45	5149.21	38.519	84	0.88	89
10/28/2005 11:57	56	10/28/2005 12:30	4751.84	35.546	85	5.67	75
6/6/2005 9:45	250	6/6/2005 13:50	4512.14	33.753	86	5.80	73
1/18/2005 0:01	328	1/18/2005 0:05	4396.53	32.888	87	0.48	97

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
11/14/2005 0:00	29	11/14/2005 0:15	3210.89	24.019	88	4.24	79
9/16/2005 8:56	47	9/16/2005 9:10	3055.65	22.858	89	2.59	85
2/17/2005 14:46	317	2/17/2005 17:00	2960.29	22.144	90	0.16	121
2/22/2005 17:17	237	2/22/2005 21:00	2562.39	19.168	91	0.67	90
3/14/2005 6:03	273	3/14/2005 10:30	2315.07	17.318	92	0.24	115
3/4/2005 13:16	58	3/4/2005 14:05	1702.70	12.737	93	1.21	86
4/28/2005 18:18	211	4/28/2005 18:30	1445.94	10.816	94	0.32	108
5/24/2005 6:09	363	5/24/2005 12:05	1320.21	9.876	95	0.65	91
3/25/2005 11:32	92	3/25/2005 12:15	1315.98	9.844	96	0.54	94
2/3/2005 15:18	126	2/3/2005 17:15	1276.06	9.546	97	0.40	99
6/22/2005 5:06	28	6/22/2005 5:30	1076.94	8.056	98	0.95	88
7/18/2005 7:56	22	7/18/2005 8:05	872.81	6.529	99	1.05	87
2/18/2005 5:45	74	2/18/2005 6:05	680.60	5.091	100	0.16	123
3/22/2005 6:00	60	3/22/2005 6:05	559.62	4.186	101	0.16	122
5/22/2005 20:04	28	5/22/2005 20:15	545.38	4.080	102	0.43	98
1/22/2005 11:21	26	1/22/2005 11:25	535.64	4.007	103	0.52	96
5/27/2005 20:46	19	5/27/2005 21:00	484.23	3.622	104	0.57	93
2/19/2005 10:10	51	2/19/2005 11:00	464.58	3.475	105	0.15	131
12/16/2005 14:31	19	12/16/2005 14:45	439.40	3.287	106	0.52	95
3/9/2005 7:04	44	3/9/2005 7:05	432.94	3.239	107	0.18	118
3/5/2005 11:00	25	3/5/2005 11:15	423.13	3.165	108	0.40	100
2/1/2005 5:51	44	2/1/2005 6:05	399.12	2.986	109	0.15	124
11/23/2005 0:06	13	11/23/2005 0:15	380.84	2.849	110	0.64	92
3/3/2005 13:01	22	3/3/2005 13:15	365.92	2.737	111	0.37	102
3/7/2005 13:16	22	3/7/2005 13:30	353.52	2.645	112	0.35	104
2/4/2005 6:00	32	2/4/2005 6:05	289.11	2.163	113	0.15	125
4/29/2005 6:02	19	4/29/2005 6:15	286.28	2.142	114	0.33	105
12/4/2005 14:17	29	12/4/2005 14:45	280.82	2.101	115	0.17	120
4/27/2005 14:18	18	4/27/2005 14:30	275.27	2.059	116	0.32	106
5/23/2005 3:22	16	5/23/2005 3:30	268.09	2.005	117	0.37	103
11/13/2005 15:04	26	11/13/2005 15:15	263.82	1.973	118	0.20	117
3/17/2005 6:01	26	3/17/2005 6:05	236.63	1.770	119	0.15	126
3/2/2005 15:33	19	3/2/2005 15:45	223.68	1.673	120	0.24	114
12/29/2005 9:52	12	12/29/2005 10:00	219.71	1.644	121	0.38	101
11/27/2005 6:37	13	11/27/2005 6:45	196.49	1.470	122	0.30	109
3/16/2005 6:02	21	3/16/2005 6:05	188.51	1.410	123	0.15	127
5/2/2005 4:22	11	5/2/2005 4:30	157.29	1.177	124	0.29	110
7/19/2005 5:38	11	7/19/2005 5:45	144.58	1.082	125	0.27	111
3/21/2005 5:49	15	3/21/2005 6:00	138.85	1.039	126	0.15	128
3/15/2005 6:03	14	3/15/2005 6:05	124.53	0.932	127	0.15	130
11/27/2005 17:08	8	11/27/2005 17:15	103.27	0.772	128	0.24	113
2/28/2005 6:01	9	2/28/2005 6:05	84.96	0.636	129	0.15	132
12/28/2005 15:24	7	12/28/2005 15:30	80.14	0.599	130	0.20	116
3/18/2005 5:52	9	3/18/2005 6:00	79.91	0.598	131	0.15	129
1/29/2005 22:38	7	1/29/2005 22:45	74.15	0.555	132	0.18	119
2/2/2005 6:03	7	2/2/2005 6:05	66.33	0.496	133	0.15	133

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-2a
Structures within Region	O-25 - O-43 & M-01 - M-42
Model ID	MO-2a.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events	134
Peak Volume:	36,349,086 ft^3
	271.91 MG
Total Volume:	168,155,903 ft^3
	1257.89 MG
Peak Rate:	2980.26 cfs

Figure 1 - MO-2a Region CSO Volume

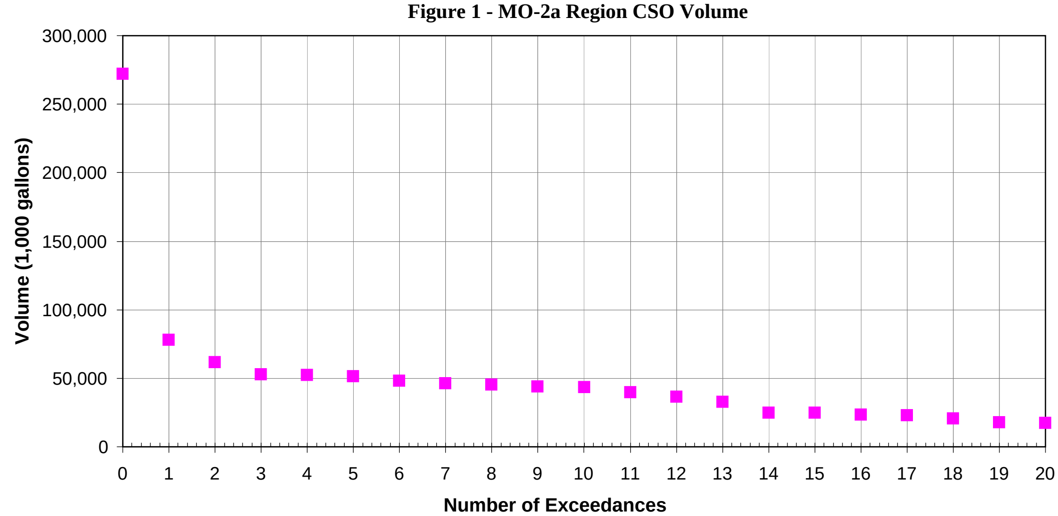
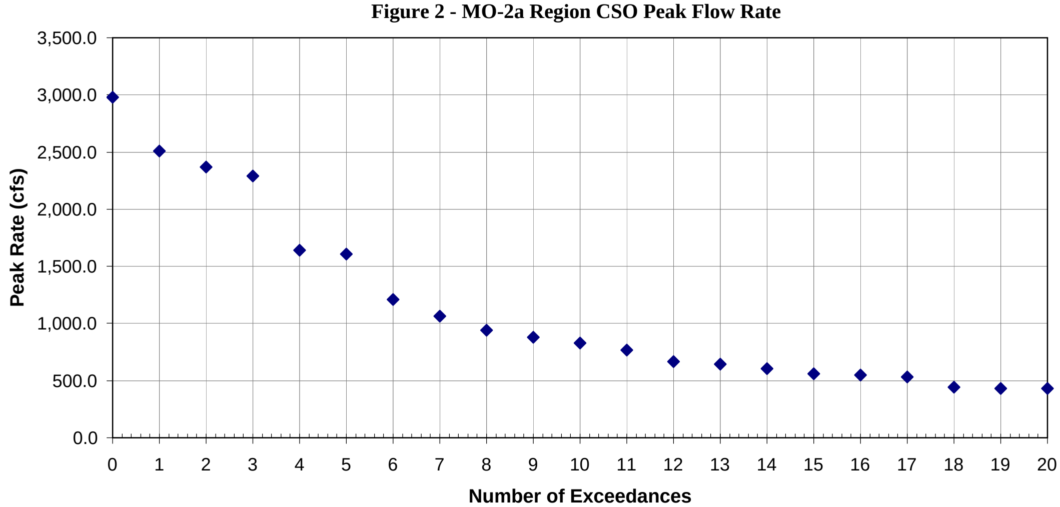


Figure 2 - MO-2a Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-3
Structures within Region	O-25 - O-43 & M-01 - M-40
Model ID	MO-3.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	135
Peak Volume:	44,334,562 ft^3
	331.64 MG
Total Volume:	198,243,270 ft^3
	1482.96 MG
Peak Rate:	2980.26 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	**Exceedance Duration (minutes)**	**Time of Peak Flow**	**(ft^3)**	**(1,000 gallons)**	**Number of Exceedances**	**(cfs)**	**Number of Exceedances**
1/5/2005 0:40	5711	1/5/2005 14:45	44334561.94	331644.691	0	745.75	13
1/10/2005 6:21	3316	1/12/2005 1:30	12938281.32	96784.813	1	730.63	14
2/14/2005 3:31	2513	2/14/2005 20:00	10348367.72	77410.965	2	279.43	33
11/29/2005 1:51	1283	11/29/2005 7:30	8225916.35	61533.967	3	629.21	16
10/24/2005 1:55	3551	10/25/2005 3:50	8082723.81	60462.815	4	305.32	31
5/13/2005 22:30	2093	5/13/2005 22:45	7966853.18	59596.045	5	1226.97	7
3/27/2005 16:06	2364	3/28/2005 19:00	7736830.66	57875.362	6	452.92	21
1/3/2005 3:20	1909	1/3/2005 14:00	7180958.45	53717.160	7	348.96	28
7/5/2005 16:15	222	7/5/2005 16:50	6816260.20	50989.034	8	2318.30	3
4/1/2005 18:31	3047	4/2/2005 6:35	6733543.74	50370.274	9	485.76	18
8/20/2005 18:06	226	8/20/2005 19:00	6705703.49	50162.015	10	2474.54	2
7/12/2005 18:50	165	7/12/2005 20:00	6155527.86	46046.426	11	2980.26	0
11/14/2005 21:30	677	11/14/2005 23:05	5443972.08	40723.633	12	590.35	17
1/12/2005 21:04	2759	1/14/2005 2:20	5307451.19	39702.389	13	374.10	26
4/22/2005 14:46	4072	4/23/2005 4:15	3778914.84	28268.172	14	1376.49	6
10/21/2005 18:46	1469	10/22/2005 6:45	3562862.71	26651.995	15	751.02	12
9/29/2005 5:00	193	9/29/2005 5:45	3551209.96	26564.826	16	2636.47	1
6/11/2005 17:25	140	6/11/2005 18:00	3169035.29	23705.968	17	1611.93	5
7/26/2005 19:38	182	7/26/2005 20:00	3056254.74	22862.314	18	1755.54	4
3/23/2005 1:17	2042	3/24/2005 9:50	2738622.41	20486.265	19	311.32	30
5/11/2005 22:30	179	5/11/2005 23:00	2651539.50	19834.841	20	1037.91	8
12/15/2005 7:39	1143	12/15/2005 14:00	2607462.63	19505.124	21	354.45	27
2/20/2005 14:15	2685	2/20/2005 20:20	2578965.74	19291.953	22	398.45	23
5/28/2005 7:46	783	5/28/2005 9:30	2247473.34	16812.224	23	485.13	19
8/8/2005 7:46	249	8/8/2005 9:15	2118776.23	15849.506	24	641.76	15
2/9/2005 6:01	1544	2/9/2005 16:45	1858426.95	13901.963	25	466.13	20
8/29/2005 8:37	475	8/29/2005 13:45	1696849.69	12693.284	26	779.06	11
7/15/2005 17:15	135	7/15/2005 18:05	1598532.97	11957.826	27	941.82	9
10/7/2005 7:00	663	10/7/2005 10:50	1534653.35	11479.974	28	374.82	25
11/16/2005 4:00	591	11/16/2005 4:15	1463497.09	10947.690	29	274.93	35
11/9/2005 19:15	106	11/9/2005 19:45	1386357.04	10370.644	30	878.03	10
7/16/2005 9:26	353	7/16/2005 12:00	1172067.88	8767.654	31	432.76	22
2/16/2005 5:30	1542	2/16/2005 8:15	1111921.86	8317.731	32	189.21	39

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
9/26/2005 5:08	746	9/26/2005 6:20	830981.71	6216.159	33	105.17	44
11/1/2005 14:31	283	11/1/2005 16:30	824979.01	6171.255	34	199.21	38
5/23/2005 10:32	496	5/23/2005 16:35	778311.97	5822.163	35	389.87	24
7/17/2005 15:51	157	7/17/2005 16:45	753116.42	5633.687	36	283.16	32
6/3/2005 5:51	306	6/3/2005 9:20	614931.45	4599.995	37	182.60	40
8/27/2005 15:15	148	8/27/2005 15:30	543896.36	4068.617	38	277.41	34
6/14/2005 18:45	119	6/14/2005 19:25	486971.92	3642.793	39	242.32	37
7/25/2005 13:05	359	7/25/2005 13:30	458982.07	3433.415	40	342.77	29
12/25/2005 10:07	307	12/25/2005 13:10	420125.94	3142.752	41	89.83	46
5/19/2005 19:23	999	5/20/2005 6:45	391891.54	2931.545	42	61.29	53
4/20/2005 18:30	366	4/20/2005 19:55	382736.25	2863.059	43	87.17	48
9/16/2005 21:15	79	9/16/2005 21:45	379343.52	2837.679	44	257.29	36
1/25/2005 17:23	1056	1/26/2005 5:10	333952.82	2498.134	45	91.18	45
1/30/2005 10:52	266	1/30/2005 13:10	228729.97	1711.015	46	73.36	51
11/8/2005 10:33	396	11/8/2005 15:15	218110.56	1631.576	47	89.80	47
12/9/2005 3:07	278	12/9/2005 4:15	205718.57	1538.878	48	74.99	50
10/20/2005 22:53	614	10/21/2005 7:35	175935.92	1316.089	49	77.47	49
7/21/2005 14:25	72	7/21/2005 15:00	174559.53	1305.793	50	118.38	43
11/9/2005 4:15	112	11/9/2005 4:30	170788.17	1277.581	51	141.53	42
5/7/2005 11:33	176	5/7/2005 13:30	167035.10	1249.506	52	71.34	52
4/26/2005 19:37	450	4/27/2005 1:00	132731.47	992.898	53	47.48	56
4/30/2005 2:10	520	4/30/2005 6:05	132677.21	992.492	54	29.19	60
11/6/2005 9:50	294	11/6/2005 10:00	127182.31	951.387	55	147.41	41
1/16/2005 11:33	1768	1/16/2005 12:25	114596.53	857.239	56	3.58	85
11/24/2005 7:52	345	11/24/2005 9:45	99067.33	741.073	57	22.14	64
12/26/2005 1:23	766	12/26/2005 6:15	88776.10	664.090	58	7.10	76
12/1/2005 4:47	943	12/1/2005 7:35	86687.88	648.469	59	3.90	84
5/21/2005 14:22	88	5/21/2005 15:20	74697.39	558.774	60	52.37	55
3/30/2005 17:58	751	3/30/2005 18:30	74239.91	555.352	61	5.10	82
3/7/2005 21:15	533	3/8/2005 0:20	71187.56	532.519	62	6.35	78
8/26/2005 18:08	585	8/26/2005 21:20	65473.46	489.774	63	26.25	63
6/16/2005 11:00	377	6/16/2005 11:35	60426.64	452.022	64	30.86	58
3/19/2005 22:51	1290	3/20/2005 7:45	59765.95	447.079	65	13.04	71
3/12/2005 10:02	436	3/12/2005 11:05	59324.94	443.780	66	17.76	67
2/25/2005 5:03	1051	2/25/2005 13:05	58762.25	439.571	67	10.95	73
6/17/2005 0:36	144	6/17/2005 1:35	56273.99	420.958	68	28.64	61
6/8/2005 21:00	76	6/8/2005 21:15	52901.64	395.731	69	39.16	57
6/10/2005 21:20	62	6/10/2005 21:35	45538.83	340.653	70	55.13	54
10/28/2005 11:57	71	10/28/2005 12:30	45001.96	336.637	71	29.20	59
6/6/2005 9:35	260	6/6/2005 10:00	44187.74	330.546	72	27.40	62
8/16/2005 5:06	227	8/16/2005 8:30	43773.61	327.448	73	16.74	68
3/11/2005 7:31	768	3/11/2005 14:00	42828.90	320.382	74	10.75	75
11/23/2005 17:38	305	11/23/2005 20:15	30979.56	231.743	75	14.34	70
12/11/2005 11:24	432	12/11/2005 16:10	23195.63	173.515	76	6.08	79
2/8/2005 1:47	831	2/8/2005 6:05	18727.22	140.089	77	5.16	81
6/28/2005 18:10	69	6/28/2005 18:15	18429.38	137.861	78	14.78	69
8/5/2005 10:47	97	8/5/2005 11:30	17895.43	133.867	79	7.02	77
7/5/2005 3:35	39	7/5/2005 3:45	17323.58	129.589	80	19.59	66
9/23/2005 2:45	51	9/23/2005 3:05	16991.67	127.106	81	20.14	65
7/18/2005 18:30	50	7/18/2005 19:00	15428.60	115.414	82	12.20	72
5/24/2005 20:52	116	5/24/2005 21:35	15142.59	113.274	83	10.94	74
2/26/2005 8:47	429	2/26/2005 12:45	8186.35	61.238	84	2.33	88
2/24/2005 10:20	658	2/24/2005 20:35	7087.57	53.019	85	0.32	108
6/22/2005 5:06	47	6/22/2005 5:30	6227.77	46.587	86	5.53	80
3/1/2005 0:09	684	3/1/2005 10:15	5668.45	42.403	87	0.26	113

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/18/2005 0:01	328	1/18/2005 0:05	4396.53	32.888	88	0.48	97
5/24/2005 6:09	384	5/24/2005 6:40	4275.87	31.986	89	2.48	87
11/14/2005 0:00	31	11/14/2005 0:15	3359.61	25.132	90	4.24	83
2/22/2005 17:17	256	2/22/2005 21:05	3263.43	24.412	91	0.74	93
9/16/2005 8:56	47	9/16/2005 9:10	3055.65	22.858	92	2.59	86
2/17/2005 14:46	317	2/17/2005 17:00	2960.29	22.144	93	0.16	122
3/14/2005 6:03	273	3/14/2005 10:30	2315.07	17.318	94	0.24	116
3/4/2005 13:16	58	3/4/2005 14:05	1702.70	12.737	95	1.21	90
4/28/2005 18:18	211	4/28/2005 18:30	1445.94	10.816	96	0.32	109
11/23/2005 0:06	31	11/23/2005 0:25	1420.14	10.623	97	1.86	89
3/25/2005 11:32	92	3/25/2005 12:15	1315.98	9.844	98	0.54	94
2/3/2005 15:18	126	2/3/2005 17:15	1276.06	9.546	99	0.40	100
7/18/2005 7:56	22	7/18/2005 8:05	872.81	6.529	100	1.05	91
2/18/2005 5:45	74	2/18/2005 6:05	680.60	5.091	101	0.16	124
5/27/2005 20:46	21	5/27/2005 21:00	615.52	4.604	102	0.82	92
3/22/2005 6:00	60	3/22/2005 6:05	559.62	4.186	103	0.16	123
5/22/2005 20:04	28	5/22/2005 20:15	545.38	4.080	104	0.43	99
1/22/2005 11:21	26	1/22/2005 11:25	535.64	4.007	105	0.52	96
2/19/2005 10:10	51	2/19/2005 11:00	464.58	3.475	106	0.15	132
12/16/2005 14:31	19	12/16/2005 14:45	439.40	3.287	107	0.52	95
3/9/2005 7:04	44	3/9/2005 7:05	432.94	3.239	108	0.18	119
3/5/2005 11:00	25	3/5/2005 11:15	423.13	3.165	109	0.40	101
2/1/2005 5:51	44	2/1/2005 6:05	399.12	2.986	110	0.15	125
3/3/2005 13:01	22	3/3/2005 13:15	365.92	2.737	111	0.37	103
3/7/2005 13:16	22	3/7/2005 13:30	353.52	2.645	112	0.35	105
2/4/2005 6:00	32	2/4/2005 6:05	289.11	2.163	113	0.15	126
4/29/2005 6:02	19	4/29/2005 6:15	286.28	2.142	114	0.33	106
12/4/2005 14:17	29	12/4/2005 14:45	280.82	2.101	115	0.17	121
4/27/2005 14:18	18	4/27/2005 14:30	275.27	2.059	116	0.32	107
5/23/2005 3:22	16	5/23/2005 3:30	268.09	2.005	117	0.37	104
11/13/2005 15:04	26	11/13/2005 15:15	263.82	1.973	118	0.20	118
3/17/2005 6:01	26	3/17/2005 6:05	236.63	1.770	119	0.15	127
3/2/2005 15:33	19	3/2/2005 15:45	223.68	1.673	120	0.24	115
12/29/2005 9:52	12	12/29/2005 10:00	219.71	1.644	121	0.38	102
11/27/2005 6:37	13	11/27/2005 6:45	196.49	1.470	122	0.30	110
3/16/2005 6:02	21	3/16/2005 6:05	188.51	1.410	123	0.15	128
5/2/2005 4:22	11	5/2/2005 4:30	157.29	1.177	124	0.29	111
7/19/2005 5:38	11	7/19/2005 5:45	144.58	1.082	125	0.27	112
3/21/2005 5:49	15	3/21/2005 6:00	138.85	1.039	126	0.15	129
3/15/2005 6:03	14	3/15/2005 6:05	124.53	0.932	127	0.15	131
11/27/2005 17:08	8	11/27/2005 17:15	103.27	0.772	128	0.24	114
2/28/2005 6:01	9	2/28/2005 6:05	84.96	0.636	129	0.15	133
12/28/2005 15:24	7	12/28/2005 15:30	80.14	0.599	130	0.20	117
3/18/2005 5:52	9	3/18/2005 6:00	79.91	0.598	131	0.15	130
1/29/2005 22:38	7	1/29/2005 22:45	74.15	0.555	132	0.18	120
2/2/2005 6:03	7	2/2/2005 6:05	66.33	0.496	133	0.15	134
1/9/2005 11:04	536	1/9/2005 11:05	-36850.72	-275.662	134	0.47	98

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-3
Structures within Region	O-25 - O-43 & M-01 - M-40
Model ID	MO-3.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events	135
Peak Volume:	44,334,562 ft^3
	331.64 MG
Total Volume:	198,243,270 ft^3
	1482.96 MG
Peak Rate:	2980.26 cfs

Figure 1 - MO-3 Region CSO Volume

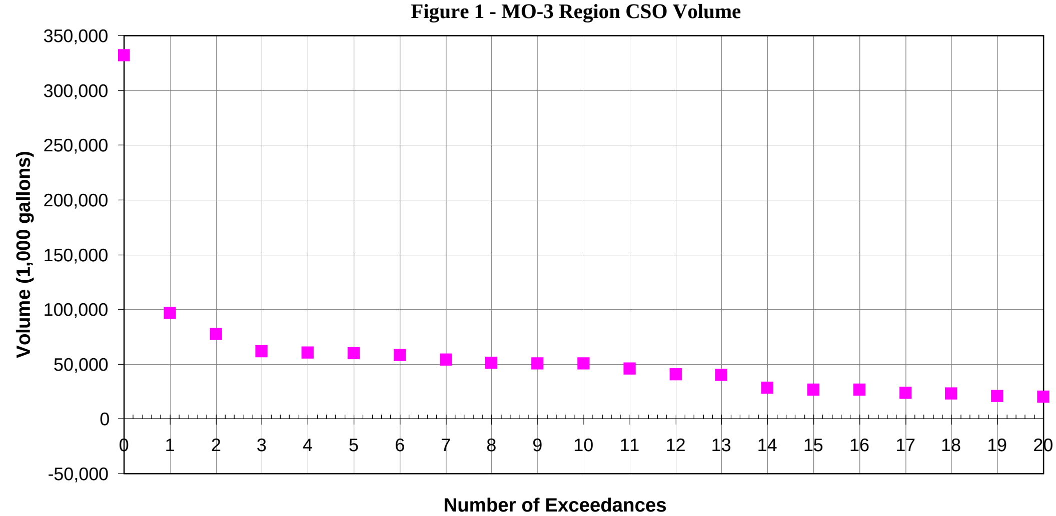
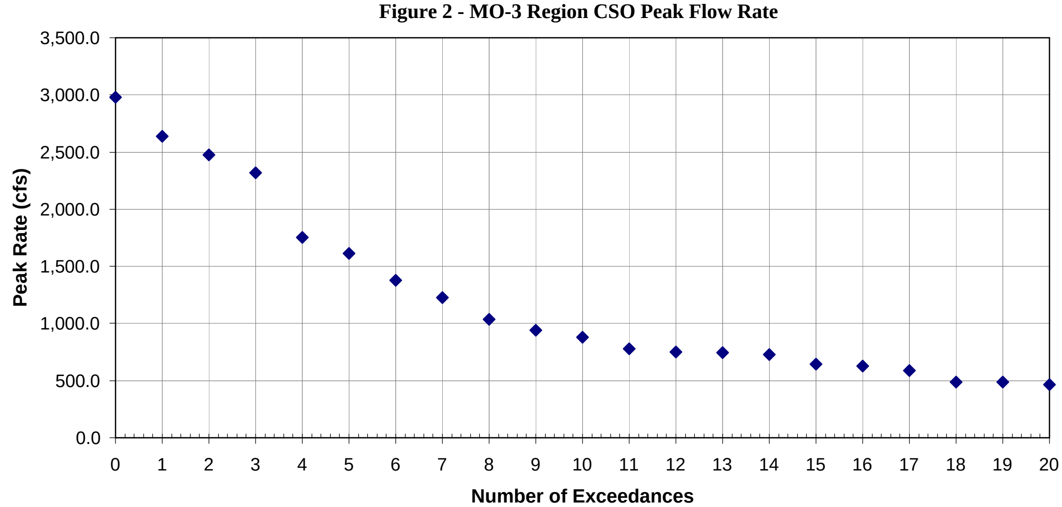


Figure 2 - MO-3 Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-4
Structures within Region	O-25 - O-43 & M-01 - M-31
Model ID	MO-4.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	137
Peak Volume:	50,332,116 ft^3
	376.51 MG
Total Volume:	217,478,786 ft^3
	1626.85 MG
Peak Rate:	2980.26 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/5/2005 0:40	5741	1/5/2005 14:45	50332116.36	376509.396	0	779.15	12
1/10/2005 6:21	3335	1/12/2005 1:30	14312831.55	107067.136	1	750.57	14
2/14/2005 3:31	2621	2/14/2005 20:00	11759686.75	87968.337	2	295.19	34
11/29/2005 1:51	1356	11/29/2005 7:30	9202113.15	68836.407	3	638.52	16
3/27/2005 16:06	2511	3/28/2005 19:05	8907457.86	66632.239	4	471.88	21
10/24/2005 1:55	3551	10/25/2005 3:50	8538987.34	63875.895	5	309.76	32
5/13/2005 22:30	2093	5/13/2005 22:45	8464955.30	63322.098	6	1227.20	7
1/3/2005 3:20	1972	1/3/2005 14:00	8198489.57	61328.801	7	365.74	27
4/1/2005 18:31	3110	4/2/2005 6:35	7774218.47	58155.041	8	501.50	18
8/20/2005 18:06	373	8/20/2005 19:00	7345650.86	54949.141	9	2524.08	2
7/5/2005 16:15	312	7/5/2005 16:50	7016915.65	52490.038	10	2322.57	3
7/12/2005 18:50	165	7/12/2005 20:00	6155527.86	46046.426	11	2980.26	0
1/12/2005 21:03	2881	1/14/2005 2:20	6104404.67	45663.999	12	393.31	24
11/14/2005 21:30	710	11/14/2005 23:05	5623159.67	42064.046	13	598.92	17
4/22/2005 14:46	4072	4/23/2005 4:15	3946367.83	29520.805	14	1376.67	6
10/21/2005 18:46	1495	10/22/2005 6:45	3686746.39	27578.706	15	751.61	13
9/29/2005 5:00	259	9/29/2005 5:45	3650578.90	27308.155	16	2638.22	1
6/11/2005 17:20	144	6/11/2005 18:00	3169670.85	23710.723	17	1611.93	5
7/26/2005 19:38	202	7/26/2005 20:00	3134304.23	23446.163	18	1756.12	4
3/23/2005 1:17	2065	3/24/2005 9:50	2996083.30	22412.201	19	311.32	31
12/15/2005 7:39	1145	12/15/2005 14:00	2962180.68	22158.593	20	363.03	28
2/20/2005 14:15	2685	2/20/2005 20:20	2951172.70	22076.247	21	408.61	23
5/11/2005 22:30	183	5/11/2005 23:00	2677369.48	20028.062	22	1041.19	8
5/28/2005 7:46	802	5/28/2005 9:30	2371260.16	17738.212	23	490.39	19
8/8/2005 7:46	249	8/8/2005 9:15	2134772.23	15969.164	24	642.64	15
2/9/2005 6:01	1544	2/9/2005 16:45	1999473.01	14957.058	25	473.65	20
8/29/2005 8:37	475	8/29/2005 13:45	1708858.59	12783.117	26	780.80	11
11/16/2005 4:00	658	11/16/2005 4:15	1682147.61	12583.305	27	274.93	36
7/15/2005 17:15	205	7/15/2005 18:05	1656136.24	12388.727	28	950.07	9
10/7/2005 7:00	663	10/7/2005 10:50	1596015.26	11938.992	29	381.33	26
11/9/2005 19:15	106	11/9/2005 19:45	1386357.04	10370.644	30	878.03	10
2/16/2005 5:30	1542	2/16/2005 8:15	1375277.36	10287.762	31	200.43	38
7/16/2005 9:26	353	7/16/2005 12:00	1172089.16	8767.813	32	432.80	22

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
7/17/2005 15:51	273	7/17/2005 16:45	1029280.11	7699.530	33	314.28	30
9/26/2005 5:08	746	9/26/2005 6:20	894061.23	6688.025	34	105.17	44
5/23/2005 10:32	619	5/23/2005 16:35	876621.36	6557.566	35	389.87	25
11/1/2005 14:31	309	11/1/2005 16:30	850651.88	6363.301	36	200.00	39
9/16/2005 21:15	290	9/16/2005 21:45	745946.45	5580.052	37	296.56	33
6/3/2005 5:51	359	6/3/2005 9:20	655825.22	4905.901	38	189.59	40
8/27/2005 15:15	148	8/27/2005 15:30	543906.57	4068.693	39	277.41	35
6/14/2005 18:45	119	6/14/2005 19:25	487280.50	3645.102	40	242.35	37
7/25/2005 13:05	359	7/25/2005 13:30	459397.74	3436.525	41	342.77	29
12/25/2005 10:07	371	12/25/2005 13:10	450606.46	3370.762	42	92.88	45
5/19/2005 19:23	999	5/20/2005 6:45	432604.68	3236.099	43	61.87	53
4/20/2005 18:30	366	4/20/2005 19:55	390726.99	2922.833	44	87.17	48
1/25/2005 17:23	1056	1/26/2005 5:10	334601.76	2502.988	45	91.18	46
1/30/2005 10:52	333	1/30/2005 13:10	249926.07	1869.572	46	73.36	51
11/8/2005 10:33	396	11/8/2005 15:15	218149.33	1631.866	47	89.83	47
12/9/2005 3:07	278	12/9/2005 4:15	205718.57	1538.878	48	74.99	50
7/21/2005 14:25	178	7/21/2005 15:00	204232.33	1527.760	49	121.21	43
10/20/2005 22:53	614	10/21/2005 7:35	175980.81	1316.424	50	77.47	49
5/7/2005 11:33	203	5/7/2005 13:30	173168.03	1295.383	51	71.36	52
11/9/2005 4:15	112	11/9/2005 4:30	170788.17	1277.581	52	141.53	42
4/30/2005 2:10	520	4/30/2005 6:05	137972.16	1032.101	53	29.19	61
4/26/2005 19:37	450	4/27/2005 1:00	132738.75	992.952	54	47.48	56
12/26/2005 1:23	766	12/26/2005 11:10	132624.51	992.098	55	8.83	76
11/6/2005 9:50	294	11/6/2005 10:00	127182.31	951.387	56	147.41	41
1/16/2005 11:33	1768	1/16/2005 12:25	114596.53	857.239	57	3.58	85
11/24/2005 7:52	345	11/24/2005 9:45	100728.31	753.498	58	22.14	64
12/1/2005 4:47	943	12/1/2005 7:35	86687.88	648.469	59	3.90	84
5/21/2005 14:22	88	5/21/2005 15:20	74697.39	558.774	60	52.37	55
3/30/2005 17:58	751	3/30/2005 18:30	74239.91	555.352	61	5.10	82
3/7/2005 21:15	533	3/8/2005 0:20	71187.56	532.519	62	6.35	78
8/26/2005 18:08	585	8/26/2005 21:20	65473.46	489.774	63	26.25	63
6/16/2005 11:00	377	6/16/2005 11:35	60426.64	452.022	64	30.86	58
6/6/2005 9:32	477	6/6/2005 10:00	59984.28	448.712	65	29.66	59
2/25/2005 5:03	1051	2/25/2005 13:05	59831.14	447.567	66	10.95	73
3/19/2005 22:51	1290	3/20/2005 7:45	59765.95	447.079	67	13.04	71
3/12/2005 10:02	436	3/12/2005 11:05	59694.90	446.548	68	17.76	67
6/8/2005 21:00	79	6/8/2005 21:15	57353.46	429.033	69	40.23	57
6/17/2005 0:36	144	6/17/2005 1:35	56273.99	420.958	70	28.64	62
6/10/2005 21:20	62	6/10/2005 21:35	45538.83	340.653	71	55.13	54
10/28/2005 11:57	71	10/28/2005 12:30	45073.82	337.175	72	29.27	60
8/16/2005 5:06	227	8/16/2005 8:30	43773.61	327.448	73	16.74	68
3/11/2005 7:31	768	3/11/2005 14:00	42828.90	320.382	74	10.75	75
11/23/2005 17:38	305	11/23/2005 20:15	30979.56	231.743	75	14.34	70
12/11/2005 11:24	432	12/11/2005 16:10	23195.63	173.515	76	6.08	79
2/8/2005 1:47	831	2/8/2005 6:05	18727.22	140.089	77	5.16	81
6/28/2005 18:10	69	6/28/2005 18:15	18429.38	137.861	78	14.78	69
8/5/2005 10:47	97	8/5/2005 11:30	17895.43	133.867	79	7.02	77
7/5/2005 3:35	40	7/5/2005 3:45	17428.59	130.375	80	19.73	66
9/23/2005 2:45	51	9/23/2005 3:05	16991.67	127.106	81	20.14	65
7/18/2005 18:30	50	7/18/2005 19:00	15428.60	115.414	82	12.20	72
5/24/2005 20:52	116	5/24/2005 21:35	15142.59	113.274	83	10.94	74
2/26/2005 8:47	429	2/26/2005 12:45	12871.75	96.287	84	2.33	88
2/24/2005 10:20	658	2/24/2005 20:35	7087.57	53.019	85	0.32	110
6/22/2005 5:06	47	6/22/2005 5:30	6227.77	46.587	86	5.53	80
3/1/2005 0:09	684	3/1/2005 10:15	5668.45	42.403	87	0.26	115

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/18/2005 0:01	328	1/18/2005 0:05	4396.53	32.888	88	0.48	100
5/24/2005 6:09	384	5/24/2005 6:40	4275.87	31.986	89	2.48	87
11/14/2005 0:00	31	11/14/2005 0:15	3359.61	25.132	90	4.24	83
2/22/2005 17:17	256	2/22/2005 21:05	3263.43	24.412	91	0.74	95
9/16/2005 8:56	47	9/16/2005 9:10	3055.65	22.858	92	2.59	86
2/17/2005 14:46	317	2/17/2005 17:00	2960.29	22.144	93	0.16	124
3/14/2005 6:03	273	3/14/2005 10:30	2315.07	17.318	94	0.24	118
3/4/2005 13:16	58	3/4/2005 14:05	1702.70	12.737	95	1.21	91
4/28/2005 18:18	211	4/28/2005 18:30	1445.94	10.816	96	0.32	111
11/23/2005 0:06	31	11/23/2005 0:25	1420.14	10.623	97	1.86	90
3/25/2005 11:32	92	3/25/2005 12:15	1315.98	9.844	98	0.54	97
2/3/2005 15:18	126	2/3/2005 17:15	1276.06	9.546	99	0.40	102
7/18/2005 7:56	22	7/18/2005 8:05	872.81	6.529	100	1.05	92
2/18/2005 5:45	74	2/18/2005 6:05	680.60	5.091	101	0.16	126
5/27/2005 20:46	21	5/27/2005 21:00	615.52	4.604	102	0.82	94
3/22/2005 6:00	60	3/22/2005 6:05	559.62	4.186	103	0.16	125
5/22/2005 20:04	28	5/22/2005 20:15	545.38	4.080	104	0.43	101
1/22/2005 11:21	26	1/22/2005 11:25	535.64	4.007	105	0.52	99
2/19/2005 10:10	51	2/19/2005 11:00	464.58	3.475	106	0.15	134
12/16/2005 14:31	19	12/16/2005 14:45	439.40	3.287	107	0.52	98
3/9/2005 7:04	44	3/9/2005 7:05	432.94	3.239	108	0.18	121
8/13/2005 19:36	13	8/13/2005 19:45	430.72	3.222	109	1.00	93
3/5/2005 11:00	25	3/5/2005 11:15	423.13	3.165	110	0.40	103
2/1/2005 5:51	44	2/1/2005 6:05	399.12	2.986	111	0.15	127
3/3/2005 13:01	22	3/3/2005 13:15	365.92	2.737	112	0.37	105
3/7/2005 13:16	22	3/7/2005 13:30	353.52	2.645	113	0.35	107
2/4/2005 6:00	32	2/4/2005 6:05	289.11	2.163	114	0.15	128
4/29/2005 6:02	19	4/29/2005 6:15	286.28	2.142	115	0.33	108
12/4/2005 14:17	29	12/4/2005 14:45	280.82	2.101	116	0.17	123
4/27/2005 14:18	18	4/27/2005 14:30	275.27	2.059	117	0.32	109
11/9/2005 12:51	12	11/9/2005 13:00	273.41	2.045	118	0.54	96
5/23/2005 3:22	16	5/23/2005 3:30	268.09	2.005	119	0.37	106
11/13/2005 15:04	26	11/13/2005 15:15	263.82	1.973	120	0.20	120
3/17/2005 6:01	26	3/17/2005 6:05	236.63	1.770	121	0.15	129
3/2/2005 15:33	19	3/2/2005 15:45	223.68	1.673	122	0.24	117
12/29/2005 9:52	12	12/29/2005 10:00	219.71	1.644	123	0.38	104
11/27/2005 6:37	13	11/27/2005 6:45	196.49	1.470	124	0.30	112
3/16/2005 6:02	21	3/16/2005 6:05	188.51	1.410	125	0.15	130
5/2/2005 4:22	11	5/2/2005 4:30	157.29	1.177	126	0.29	113
7/19/2005 5:38	11	7/19/2005 5:45	144.58	1.082	127	0.27	114
3/21/2005 5:49	15	3/21/2005 6:00	138.85	1.039	128	0.15	131
3/15/2005 6:03	14	3/15/2005 6:05	124.53	0.932	129	0.15	133
11/27/2005 17:08	8	11/27/2005 17:15	103.27	0.772	130	0.24	116
2/28/2005 6:01	9	2/28/2005 6:05	84.96	0.636	131	0.15	135
12/28/2005 15:24	7	12/28/2005 15:30	80.14	0.599	132	0.20	119
3/18/2005 5:52	9	3/18/2005 6:00	79.91	0.598	133	0.15	132
1/29/2005 22:38	7	1/29/2005 22:45	74.15	0.555	134	0.18	122
2/2/2005 6:03	7	2/2/2005 6:05	66.33	0.496	135	0.15	136
1/9/2005 10:04	596	1/9/2005 11:05	-20774.86	-155.406	136	2.17	89

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-4	**Results Summary**	
Structures within Region	O-25 - O-43 & M-01 - M-31	Number of Events	137
Model ID	MO-4.1	Peak Volume:	50,332,116 ft^3
Structure Type			376.51 MG
PWSA Sewershed		Total Volume:	217,478,786 ft^3
Stream of Discharge			1626.85 MG
NPDES Permit Number		Peak Rate:	2980.26 cfs
Owner			
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2		
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection		

Figure 1 - MO-4 Region CSO Volume

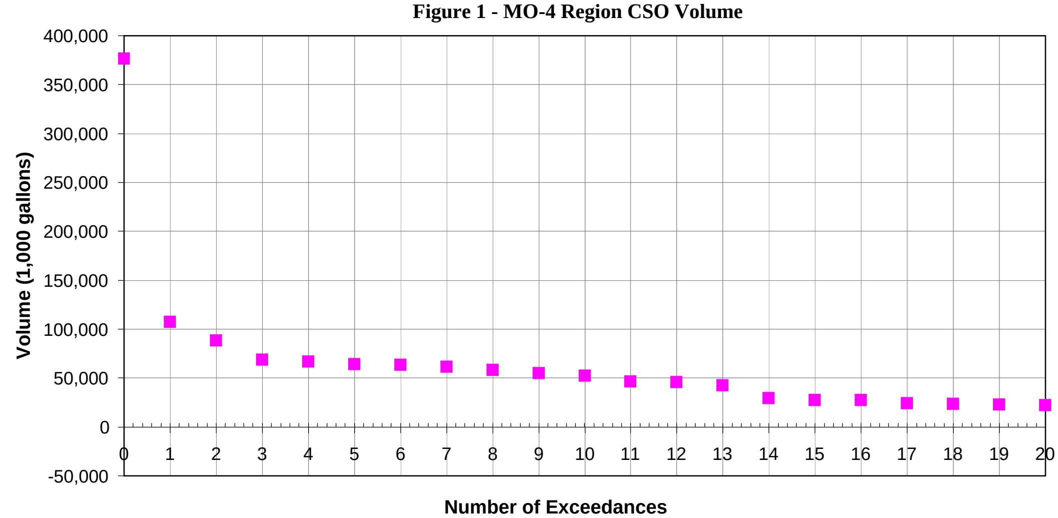
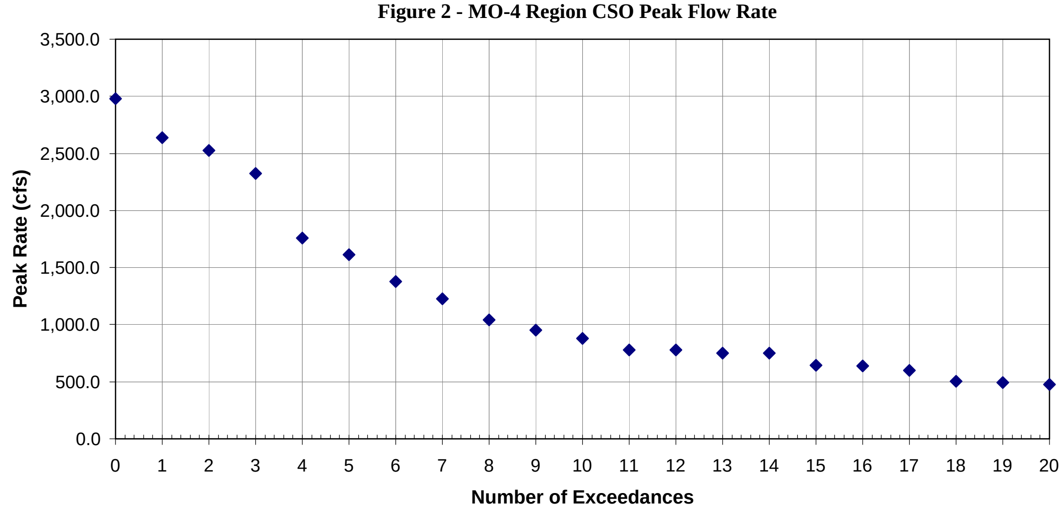


Figure 2 - MO-4 Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-5
Structures within Region	O-25 - O-43 & M-01 - M-28
Model ID	MO-5.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	137
Peak Volume:	56,164,065 ft^3
	420.14 MG
Total Volume:	240,862,894 ft^3
	1801.77 MG
Peak Rate:	2980.26 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/5/2005 0:40	5741	1/5/2005 14:45	56164065.30	420135.291	0	811.98	11
1/10/2005 6:21	3352	1/12/2005 1:30	16567519.38	123933.329	1	777.10	13
2/14/2005 3:31	2621	2/14/2005 20:00	13943998.61	104308.082	2	321.61	31
3/27/2005 16:06	2514	3/28/2005 19:05	10271780.13	76838.051	3	498.04	20
1/3/2005 3:20	2225	1/3/2005 14:00	10228694.73	76515.751	4	391.31	26
11/29/2005 1:51	1356	11/29/2005 7:30	10025744.96	74997.585	5	642.20	16
4/1/2005 18:31	3110	4/2/2005 6:35	9516634.57	71189.185	6	520.29	18
10/24/2005 1:55	3551	10/25/2005 3:50	9312412.91	69661.505	7	322.49	30
5/13/2005 22:30	2252	5/13/2005 22:45	9240742.73	69125.376	8	1227.20	7
8/20/2005 18:06	373	8/20/2005 19:00	7538819.98	56394.143	9	2549.18	2
7/5/2005 16:15	312	7/5/2005 16:50	7136301.94	53383.107	10	2322.57	3
1/12/2005 21:03	2906	1/14/2005 2:20	7048055.88	52722.982	11	413.97	24
7/12/2005 18:50	165	7/12/2005 20:00	6155527.86	46046.426	12	2980.26	0
11/14/2005 21:30	712	11/14/2005 23:05	5871343.19	43920.583	13	614.21	17
4/22/2005 14:46	4072	4/23/2005 4:15	4129316.87	30889.355	14	1376.67	6
10/21/2005 18:46	1505	10/22/2005 6:45	3871209.25	28958.581	15	751.61	14
9/29/2005 5:00	259	9/29/2005 5:45	3734176.44	27933.507	16	2638.22	1
2/20/2005 14:15	2685	2/20/2005 20:20	3718482.17	27816.106	17	428.08	23
12/15/2005 7:39	1483	12/15/2005 14:00	3483555.86	26058.740	18	381.94	28
3/23/2005 1:17	2065	3/24/2005 9:50	3351314.63	25069.509	19	311.32	33
6/11/2005 17:20	160	6/11/2005 18:00	3202595.67	23957.017	20	1615.66	5
7/26/2005 19:38	202	7/26/2005 20:00	3189433.75	23858.559	21	1756.12	4
5/11/2005 22:30	184	5/11/2005 23:00	2753384.25	20596.691	22	1041.19	8
5/28/2005 7:46	961	5/28/2005 9:30	2663935.12	19927.567	23	502.42	19
8/8/2005 7:46	255	8/8/2005 9:15	2270557.97	16984.909	24	642.64	15
2/9/2005 6:01	1634	2/9/2005 16:45	2224467.54	16640.129	25	490.17	21
11/16/2005 4:00	658	11/16/2005 4:15	1821881.20	13628.582	26	274.93	36
2/16/2005 5:30	1542	2/16/2005 8:15	1784704.35	13350.481	27	220.00	38
10/7/2005 7:00	663	10/7/2005 10:50	1733118.43	12964.592	28	396.74	25
8/29/2005 8:37	475	8/29/2005 13:45	1732546.11	12960.311	29	784.63	12
7/15/2005 17:15	205	7/15/2005 18:05	1656136.24	12388.727	30	950.07	9
11/9/2005 19:15	126	11/9/2005 19:45	1390681.60	10402.994	31	878.03	10
7/16/2005 9:26	353	7/16/2005 12:00	1177797.92	8810.517	32	432.80	22

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
7/17/2005 15:51	273	7/17/2005 16:45	1064519.75	7963.140	33	314.28	32
9/26/2005 5:08	746	9/26/2005 9:50	977750.64	7314.064	34	110.12	44
11/1/2005 14:31	312	11/1/2005 16:30	922199.20	6898.511	35	202.69	39
5/23/2005 10:32	619	5/23/2005 16:35	912074.33	6822.772	36	389.87	27
9/16/2005 21:15	290	9/16/2005 21:45	745946.45	5580.052	37	296.56	34
6/3/2005 5:51	359	6/3/2005 9:20	692340.08	5179.050	38	197.18	40
8/27/2005 15:15	148	8/27/2005 15:30	543906.57	4068.693	39	277.41	35
12/25/2005 10:07	371	12/25/2005 13:10	509202.91	3809.092	40	101.16	45
6/14/2005 18:45	138	6/14/2005 19:25	497162.80	3719.026	41	242.35	37
7/25/2005 13:05	359	7/25/2005 13:30	459397.74	3436.525	42	342.77	29
5/19/2005 19:23	999	5/20/2005 6:45	453774.69	3394.462	43	61.87	53
4/20/2005 18:30	366	4/20/2005 19:55	425329.05	3181.674	44	87.17	48
1/25/2005 17:23	1056	1/26/2005 5:10	334601.76	2502.988	45	91.18	46
1/30/2005 10:52	333	1/30/2005 13:10	259139.11	1938.490	46	73.36	51
11/8/2005 10:33	396	11/8/2005 15:15	218149.33	1631.866	47	89.83	47
12/9/2005 3:07	278	12/9/2005 4:15	205718.57	1538.878	48	74.99	50
7/21/2005 14:25	178	7/21/2005 15:00	204232.33	1527.760	49	121.21	43
12/26/2005 1:23	769	12/26/2005 11:15	197424.58	1476.835	50	13.79	71
10/20/2005 22:53	614	10/21/2005 7:35	175980.81	1316.424	51	77.47	49
5/7/2005 11:33	203	5/7/2005 13:30	173168.03	1295.383	52	71.36	52
11/9/2005 4:15	112	11/9/2005 4:30	170788.17	1277.581	53	141.53	42
4/30/2005 2:10	520	4/30/2005 6:05	137972.16	1032.101	54	29.19	61
4/26/2005 19:37	450	4/27/2005 1:00	132738.75	992.952	55	47.48	56
11/6/2005 9:50	294	11/6/2005 10:00	127182.31	951.387	56	147.41	41
1/16/2005 11:33	1768	1/16/2005 12:25	114596.53	857.239	57	3.58	85
11/24/2005 7:52	345	11/24/2005 9:45	106601.91	797.436	58	22.14	64
12/1/2005 4:47	943	12/1/2005 7:35	86687.88	648.469	59	3.90	84
5/21/2005 14:22	88	5/21/2005 15:20	74697.39	558.774	60	52.37	55
3/30/2005 17:58	751	3/30/2005 18:30	74239.91	555.352	61	5.10	82
3/7/2005 21:15	533	3/8/2005 0:20	71187.56	532.519	62	6.35	78
8/26/2005 18:08	585	8/26/2005 21:20	65473.46	489.774	63	26.25	63
6/16/2005 11:00	377	6/16/2005 11:35	60426.64	452.022	64	30.86	58
6/6/2005 9:32	477	6/6/2005 10:00	59984.28	448.712	65	29.66	59
2/25/2005 5:03	1051	2/25/2005 13:05	59831.14	447.567	66	10.95	74
3/19/2005 22:51	1290	3/20/2005 7:45	59765.95	447.079	67	13.04	72
3/12/2005 10:02	436	3/12/2005 11:05	59694.90	446.548	68	17.76	67
6/8/2005 21:00	79	6/8/2005 21:15	57353.46	429.033	69	40.23	57
6/17/2005 0:36	144	6/17/2005 1:35	56273.99	420.958	70	28.64	62
6/10/2005 21:20	62	6/10/2005 21:35	45538.83	340.653	71	55.13	54
10/28/2005 11:57	71	10/28/2005 12:30	45073.82	337.175	72	29.27	60
8/16/2005 5:06	227	8/16/2005 8:30	43773.61	327.448	73	16.74	68
3/11/2005 7:31	768	3/11/2005 14:00	42828.90	320.382	74	10.75	76
11/23/2005 17:38	305	11/23/2005 20:15	30979.56	231.743	75	14.34	70
12/11/2005 11:24	432	12/11/2005 16:10	23195.63	173.515	76	6.08	79
2/8/2005 1:47	831	2/8/2005 6:05	18727.22	140.089	77	5.16	81
6/28/2005 18:10	69	6/28/2005 18:15	18429.38	137.861	78	14.78	69
8/5/2005 10:47	97	8/5/2005 11:30	17895.43	133.867	79	7.02	77
7/5/2005 3:35	40	7/5/2005 3:45	17428.59	130.375	80	19.73	66
9/23/2005 2:45	51	9/23/2005 3:05	16991.67	127.106	81	20.14	65
7/18/2005 18:30	50	7/18/2005 19:00	15428.60	115.414	82	12.20	73
5/24/2005 20:52	116	5/24/2005 21:35	15142.59	113.274	83	10.94	75
2/26/2005 8:47	429	2/26/2005 12:45	12871.75	96.287	84	2.33	88
2/24/2005 10:20	658	2/24/2005 20:35	7087.57	53.019	85	0.32	110
6/22/2005 5:06	47	6/22/2005 5:30	6227.77	46.587	86	5.53	80
3/1/2005 0:09	684	3/1/2005 10:15	5668.45	42.403	87	0.26	115

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/18/2005 0:01	328	1/18/2005 0:05	4396.53	32.888	88	0.48	100
5/24/2005 6:09	384	5/24/2005 6:40	4275.87	31.986	89	2.48	87
11/14/2005 0:00	31	11/14/2005 0:15	3359.61	25.132	90	4.24	83
2/22/2005 17:17	256	2/22/2005 21:05	3263.43	24.412	91	0.74	95
9/16/2005 8:56	47	9/16/2005 9:10	3055.65	22.858	92	2.59	86
2/17/2005 14:46	317	2/17/2005 17:00	2960.29	22.144	93	0.16	124
3/14/2005 6:03	273	3/14/2005 10:30	2315.07	17.318	94	0.24	118
3/4/2005 13:16	58	3/4/2005 14:05	1702.70	12.737	95	1.21	91
4/28/2005 18:18	211	4/28/2005 18:30	1445.94	10.816	96	0.32	111
11/23/2005 0:06	31	11/23/2005 0:25	1420.14	10.623	97	1.86	90
3/25/2005 11:32	92	3/25/2005 12:15	1315.98	9.844	98	0.54	97
2/3/2005 15:18	126	2/3/2005 17:15	1276.06	9.546	99	0.40	102
7/18/2005 7:56	22	7/18/2005 8:05	872.81	6.529	100	1.05	92
2/18/2005 5:45	74	2/18/2005 6:05	680.60	5.091	101	0.16	126
5/27/2005 20:46	21	5/27/2005 21:00	615.52	4.604	102	0.82	94
3/22/2005 6:00	60	3/22/2005 6:05	559.62	4.186	103	0.16	125
5/22/2005 20:04	28	5/22/2005 20:15	545.38	4.080	104	0.43	101
1/22/2005 11:21	26	1/22/2005 11:25	535.64	4.007	105	0.52	99
2/19/2005 10:10	51	2/19/2005 11:00	464.58	3.475	106	0.15	134
12/16/2005 14:31	19	12/16/2005 14:45	439.40	3.287	107	0.52	98
3/9/2005 7:04	44	3/9/2005 7:05	432.94	3.239	108	0.18	121
8/13/2005 19:36	13	8/13/2005 19:45	430.72	3.222	109	1.00	93
3/5/2005 11:00	25	3/5/2005 11:15	423.13	3.165	110	0.40	103
2/1/2005 5:51	44	2/1/2005 6:05	399.12	2.986	111	0.15	127
3/3/2005 13:01	22	3/3/2005 13:15	365.92	2.737	112	0.37	105
3/7/2005 13:16	22	3/7/2005 13:30	353.52	2.645	113	0.35	107
2/4/2005 6:00	32	2/4/2005 6:05	289.11	2.163	114	0.15	128
4/29/2005 6:02	19	4/29/2005 6:15	286.28	2.142	115	0.33	108
12/4/2005 14:17	29	12/4/2005 14:45	280.82	2.101	116	0.17	123
4/27/2005 14:18	18	4/27/2005 14:30	275.27	2.059	117	0.32	109
11/9/2005 12:51	12	11/9/2005 13:00	273.41	2.045	118	0.54	96
5/23/2005 3:22	16	5/23/2005 3:30	268.09	2.005	119	0.37	106
11/13/2005 15:04	26	11/13/2005 15:15	263.82	1.973	120	0.20	120
3/17/2005 6:01	26	3/17/2005 6:05	236.63	1.770	121	0.15	129
3/2/2005 15:33	19	3/2/2005 15:45	223.68	1.673	122	0.24	117
12/29/2005 9:52	12	12/29/2005 10:00	219.71	1.644	123	0.38	104
11/27/2005 6:37	13	11/27/2005 6:45	196.49	1.470	124	0.30	112
3/16/2005 6:02	21	3/16/2005 6:05	188.51	1.410	125	0.15	130
5/2/2005 4:22	11	5/2/2005 4:30	157.29	1.177	126	0.29	113
7/19/2005 5:38	11	7/19/2005 5:45	144.58	1.082	127	0.27	114
3/21/2005 5:49	15	3/21/2005 6:00	138.85	1.039	128	0.15	131
3/15/2005 6:03	14	3/15/2005 6:05	124.53	0.932	129	0.15	133
11/27/2005 17:08	8	11/27/2005 17:15	103.27	0.772	130	0.24	116
2/28/2005 6:01	9	2/28/2005 6:05	84.96	0.636	131	0.15	135
12/28/2005 15:24	7	12/28/2005 15:30	80.14	0.599	132	0.20	119
3/18/2005 5:52	9	3/18/2005 6:00	79.91	0.598	133	0.15	132
1/29/2005 22:38	7	1/29/2005 22:45	74.15	0.555	134	0.18	122
2/2/2005 6:03	7	2/2/2005 6:05	66.33	0.496	135	0.15	136
1/9/2005 10:04	596	1/9/2005 11:05	-20809.91	-155.669	136	2.17	89

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-5	**Results Summary**	
Structures within Region	O-25 - O-43 & M-01 - M-28	Number of Events	137
Model ID	MO-5.1	Peak Volume:	56,164,065 ft^3
Structure Type			420.14 MG
PWSA Sewershed		Total Volume:	240,862,894 ft^3
Stream of Discharge			1801.77 MG
NPDES Permit Number		Peak Rate:	2980.26 cfs
Owner			
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2		
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection		

Figure 1 - MO-5 Region CSO Volume

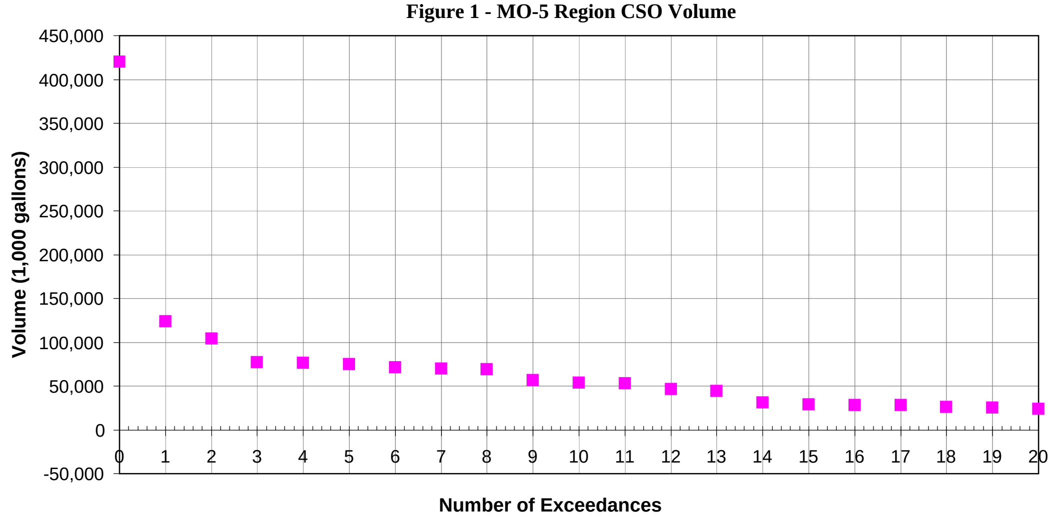
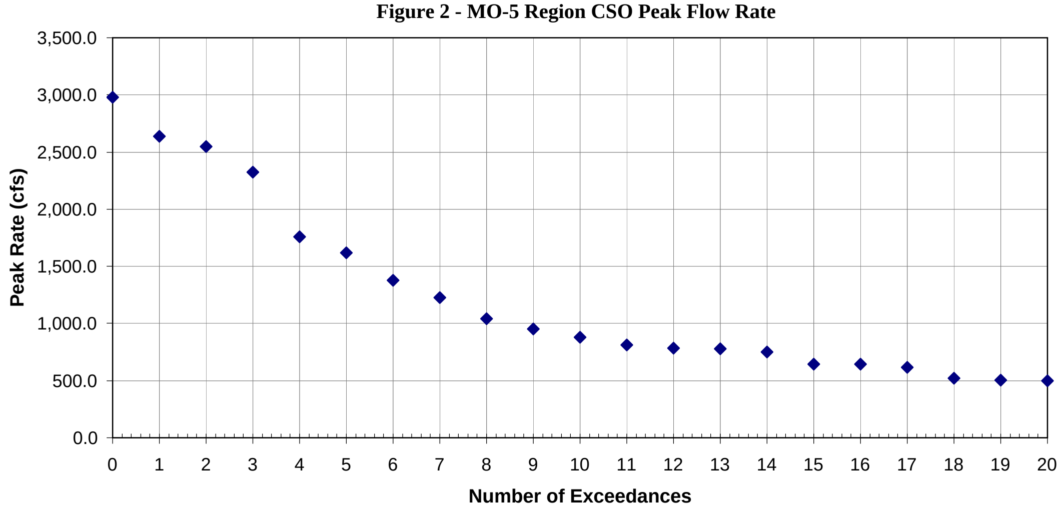


Figure 2 - MO-5 Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-6
Structures within Region	O-25 - O-43 & M-01 - M-47
Model ID	MO-6.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	135
Peak Volume:	42,175,947 ft^3
	315.50 MG
Total Volume:	191,426,623 ft^3
	1431.97 MG
Peak Rate:	2980.26 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	**Exceedance Duration (minutes)**	**Time of Peak Flow**	**(ft^3)**	**(1,000 gallons)**	**Number of Exceedances**	**(cfs)**	**Number of Exceedances**
1/5/2005 0:40	5625	1/5/2005 14:50	42175946.99	315497.171	0	699.07	12
1/10/2005 6:52	3286	1/12/2005 1:30	12651106.17	94636.600	1	667.77	13
2/14/2005 3:31	2579	2/14/2005 20:00	10444425.32	78129.524	2	263.47	33
11/29/2005 1:51	1258	11/29/2005 7:30	7888921.26	59013.075	3	555.13	16
1/3/2005 3:20	2171	1/3/2005 14:00	7815003.49	58460.134	4	338.85	28
5/13/2005 22:30	2252	5/13/2005 22:45	7755882.81	58017.881	5	1066.04	7
10/24/2005 1:55	3551	10/25/2005 3:50	7628837.19	57067.517	6	288.51	31
3/28/2005 7:30	1461	3/28/2005 19:00	7056891.15	52789.074	7	438.58	21
4/1/2005 18:31	3050	4/2/2005 6:35	7054888.45	52774.093	8	461.41	18
7/5/2005 16:15	258	7/5/2005 16:35	6555641.94	49039.480	9	2291.92	3
8/20/2005 18:06	264	8/20/2005 19:00	6258927.63	46819.908	10	2393.12	2
7/12/2005 18:50	165	7/12/2005 20:00	6155527.86	46046.426	11	2980.26	0
1/12/2005 21:04	2760	1/14/2005 2:15	5285976.88	39541.750	12	362.24	25
11/14/2005 21:30	708	11/14/2005 23:05	5110484.03	38228.976	13	546.61	17
4/22/2005 14:46	4071	4/23/2005 4:15	3491933.15	26121.406	14	1211.89	6
9/29/2005 5:00	242	9/29/2005 5:45	3382910.88	25305.865	15	2507.60	1
10/21/2005 18:46	1505	10/22/2005 6:45	3216987.62	24064.676	16	558.84	15
6/11/2005 17:30	150	6/11/2005 18:00	3126549.31	23388.152	17	1609.41	5
7/26/2005 19:38	182	7/26/2005 20:00	2802964.91	20967.579	18	1640.53	4
3/23/2005 1:17	2042	3/24/2005 9:50	2697260.71	20176.859	19	311.32	30
2/20/2005 14:15	2685	2/20/2005 20:05	2691652.14	20134.904	20	366.11	24
12/15/2005 7:39	1483	12/15/2005 14:00	2580074.29	19300.246	21	335.14	29
5/11/2005 22:30	182	5/11/2005 23:00	2394324.02	17910.741	22	877.97	9
5/28/2005 7:46	961	5/28/2005 9:30	2220353.97	16609.358	23	443.96	20
8/8/2005 8:26	215	8/8/2005 9:15	1952855.38	14608.335	24	603.46	14
2/9/2005 6:01	1048	2/9/2005 16:45	1816044.08	13584.918	25	446.57	19
8/29/2005 8:37	475	8/29/2005 13:45	1606530.29	12017.650	26	770.03	11
7/15/2005 17:15	124	7/15/2005 18:05	1594303.02	11926.184	27	941.82	8
10/7/2005 7:00	652	10/7/2005 10:50	1436021.32	10742.158	28	346.53	26
11/9/2005 19:15	126	11/9/2005 19:45	1341310.26	10033.671	29	828.39	10
11/16/2005 4:00	578	11/16/2005 4:15	1335468.16	9989.970	30	268.72	32
2/16/2005 5:30	1033	2/16/2005 8:15	1231094.41	9209.202	31	174.42	37
7/16/2005 9:26	353	7/16/2005 12:00	1062243.93	7946.116	32	375.67	23

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
9/26/2005 5:08	746	9/26/2005 6:25	777098.22	5813.083	33	94.33	44
11/1/2005 14:31	311	11/1/2005 16:30	767414.51	5740.644	34	177.36	36
5/23/2005 10:32	539	5/23/2005 16:35	715545.32	5352.637	35	389.87	22
3/27/2005 16:06	372	3/27/2005 18:00	658594.38	4926.615	36	151.39	41
7/17/2005 15:51	186	7/17/2005 16:35	571794.43	4277.308	37	169.71	38
6/3/2005 5:51	331	6/3/2005 9:20	528691.04	3954.873	38	165.96	39
8/27/2005 15:15	148	8/27/2005 15:30	504359.08	3772.858	39	261.06	34
6/14/2005 18:45	138	6/14/2005 19:30	441573.85	3303.193	40	221.92	35
7/25/2005 13:05	359	7/25/2005 13:30	417413.40	3122.461	41	342.38	27
12/25/2005 10:07	354	12/25/2005 13:10	386757.83	2893.142	42	85.15	45
5/19/2005 19:23	999	5/20/2005 6:45	348881.51	2609.808	43	58.97	54
4/20/2005 18:30	366	4/20/2005 19:55	348255.73	2605.127	44	79.63	48
1/25/2005 17:23	1056	1/26/2005 5:15	301622.52	2256.287	45	84.80	47
9/16/2005 21:15	79	9/16/2005 21:45	247573.12	1851.971	46	151.65	40
12/9/2005 3:07	274	12/9/2005 4:15	199094.72	1489.328	47	72.01	49
1/30/2005 10:52	264	1/30/2005 13:10	187227.71	1400.557	48	69.12	51
11/8/2005 10:33	396	11/8/2005 15:15	177555.68	1328.205	49	71.96	50
11/9/2005 4:15	110	11/9/2005 4:30	159990.26	1196.807	50	141.53	43
10/20/2005 22:53	606	10/21/2005 7:35	139466.95	1043.283	51	59.02	53
5/7/2005 11:33	167	5/7/2005 13:30	127695.76	955.228	52	62.15	52
11/6/2005 9:50	294	11/6/2005 10:00	126784.59	948.412	53	147.41	42
4/26/2005 19:37	450	4/27/2005 1:00	116937.20	874.749	54	45.34	56
1/16/2005 11:33	1768	1/16/2005 12:45	114243.57	854.599	55	3.47	83
4/30/2005 4:15	395	4/30/2005 6:05	106287.35	795.083	56	27.25	59
12/26/2005 1:23	769	12/26/2005 11:15	102977.03	770.320	57	7.05	73
7/21/2005 14:25	59	7/21/2005 14:45	100192.79	749.492	58	85.05	46
12/1/2005 4:47	943	12/1/2005 7:35	86687.88	648.469	59	3.90	80
3/30/2005 17:58	751	3/30/2005 18:30	74239.91	555.352	60	5.10	77
11/24/2005 7:52	345	11/24/2005 9:45	69959.47	523.332	61	19.55	62
5/21/2005 14:22	88	5/21/2005 15:25	56232.91	420.650	62	43.38	57
6/16/2005 11:00	377	6/16/2005 11:35	55827.66	417.619	63	27.82	58
8/26/2005 18:08	571	8/26/2005 21:20	51822.57	387.659	64	25.59	60
3/12/2005 10:02	436	3/12/2005 11:05	47649.97	356.446	65	15.32	63
3/19/2005 22:51	1290	3/20/2005 7:45	46324.31	346.529	66	11.46	67
6/10/2005 21:20	62	6/10/2005 21:35	45538.83	340.653	67	55.13	55
3/7/2005 21:15	533	3/8/2005 0:30	41874.51	313.242	68	3.72	82
6/17/2005 0:36	141	6/17/2005 1:35	41572.98	310.987	69	23.90	61
2/25/2005 5:03	1051	2/25/2005 13:45	41352.61	309.338	70	7.66	72
3/11/2005 7:31	768	3/11/2005 8:30	37743.64	282.341	71	10.22	69
8/16/2005 5:06	222	8/16/2005 8:30	34177.20	255.663	72	13.62	66
11/23/2005 17:38	289	11/23/2005 20:15	20283.77	151.733	73	9.95	71
6/28/2005 18:10	69	6/28/2005 18:15	18429.38	137.861	74	14.78	65
5/24/2005 20:52	116	5/24/2005 21:35	15142.59	113.274	75	10.94	68
9/23/2005 2:45	51	9/23/2005 3:05	14102.49	105.494	76	15.30	64
12/11/2005 11:24	420	12/11/2005 16:15	13843.81	103.559	77	4.65	78
2/8/2005 1:47	831	2/8/2005 12:30	13610.17	101.811	78	2.85	84
7/18/2005 18:30	46	7/18/2005 19:00	13340.67	99.795	79	10.17	70
6/8/2005 21:00	68	6/8/2005 21:20	11898.61	89.008	80	5.72	75
8/5/2005 10:47	82	8/5/2005 11:30	10157.65	75.984	81	3.89	81
2/24/2005 10:20	658	2/24/2005 20:35	7087.57	53.019	82	0.32	108
2/10/2005 6:01	189	2/10/2005 7:25	6909.39	51.686	83	0.96	88
3/1/2005 0:09	684	3/1/2005 10:15	5668.45	42.403	84	0.26	113
2/26/2005 8:47	429	2/26/2005 12:45	5149.21	38.519	85	0.88	90
10/28/2005 11:57	56	10/28/2005 12:30	4751.84	35.546	86	5.67	76
6/6/2005 9:45	250	6/6/2005 13:50	4512.14	33.753	87	5.80	74

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/18/2005 0:01	328	1/18/2005 0:05	4396.53	32.888	88	0.48	98
11/14/2005 0:00	29	11/14/2005 0:15	3210.89	24.019	89	4.24	79
9/16/2005 8:56	47	9/16/2005 9:10	3055.65	22.858	90	2.59	85
2/17/2005 14:46	317	2/17/2005 17:00	2960.29	22.144	91	0.16	122
2/22/2005 17:17	237	2/22/2005 21:00	2562.39	19.168	92	0.67	91
3/14/2005 6:03	273	3/14/2005 10:30	2315.07	17.318	93	0.24	116
3/4/2005 13:16	58	3/4/2005 14:05	1702.70	12.737	94	1.21	86
4/28/2005 18:18	211	4/28/2005 18:30	1445.94	10.816	95	0.32	109
5/24/2005 6:09	363	5/24/2005 12:05	1320.21	9.876	96	0.65	92
3/25/2005 11:32	92	3/25/2005 12:15	1315.98	9.844	97	0.54	95
2/3/2005 15:18	126	2/3/2005 17:15	1276.06	9.546	98	0.40	100
6/22/2005 5:06	28	6/22/2005 5:30	1076.94	8.056	99	0.95	89
7/18/2005 7:56	22	7/18/2005 8:05	872.81	6.529	100	1.05	87
2/18/2005 5:45	74	2/18/2005 6:05	680.60	5.091	101	0.16	124
3/22/2005 6:00	60	3/22/2005 6:05	559.62	4.186	102	0.16	123
5/22/2005 20:04	28	5/22/2005 20:15	545.38	4.080	103	0.43	99
1/22/2005 11:21	26	1/22/2005 11:25	535.64	4.007	104	0.52	97
5/27/2005 20:46	19	5/27/2005 21:00	484.23	3.622	105	0.57	94
2/19/2005 10:10	51	2/19/2005 11:00	464.58	3.475	106	0.15	132
12/16/2005 14:31	19	12/16/2005 14:45	439.40	3.287	107	0.52	96
3/9/2005 7:04	44	3/9/2005 7:05	432.94	3.239	108	0.18	119
3/5/2005 11:00	25	3/5/2005 11:15	423.13	3.165	109	0.40	101
2/1/2005 5:51	44	2/1/2005 6:05	399.12	2.986	110	0.15	125
11/23/2005 0:06	13	11/23/2005 0:15	380.84	2.849	111	0.64	93
3/3/2005 13:01	22	3/3/2005 13:15	365.92	2.737	112	0.37	103
3/7/2005 13:16	22	3/7/2005 13:30	353.52	2.645	113	0.35	105
2/4/2005 6:00	32	2/4/2005 6:05	289.11	2.163	114	0.15	126
4/29/2005 6:02	19	4/29/2005 6:15	286.28	2.142	115	0.33	106
12/4/2005 14:17	29	12/4/2005 14:45	280.82	2.101	116	0.17	121
4/27/2005 14:18	18	4/27/2005 14:30	275.27	2.059	117	0.32	107
5/23/2005 3:22	16	5/23/2005 3:30	268.09	2.005	118	0.37	104
11/13/2005 15:04	26	11/13/2005 15:15	263.82	1.973	119	0.20	118
3/17/2005 6:01	26	3/17/2005 6:05	236.63	1.770	120	0.15	127
3/2/2005 15:33	19	3/2/2005 15:45	223.68	1.673	121	0.24	115
12/29/2005 9:52	12	12/29/2005 10:00	219.71	1.644	122	0.38	102
11/27/2005 6:37	13	11/27/2005 6:45	196.49	1.470	123	0.30	110
3/16/2005 6:02	21	3/16/2005 6:05	188.51	1.410	124	0.15	128
5/2/2005 4:22	11	5/2/2005 4:30	157.29	1.177	125	0.29	111
7/19/2005 5:38	11	7/19/2005 5:45	144.58	1.082	126	0.27	112
3/21/2005 5:49	15	3/21/2005 6:00	138.85	1.039	127	0.15	129
3/15/2005 6:03	14	3/15/2005 6:05	124.53	0.932	128	0.15	131
11/27/2005 17:08	8	11/27/2005 17:15	103.27	0.772	129	0.24	114
2/28/2005 6:01	9	2/28/2005 6:05	84.96	0.636	130	0.15	133
12/28/2005 15:24	7	12/28/2005 15:30	80.14	0.599	131	0.20	117
3/18/2005 5:52	9	3/18/2005 6:00	79.91	0.598	132	0.15	130
1/29/2005 22:38	7	1/29/2005 22:45	74.15	0.555	133	0.18	120
2/2/2005 6:03	7	2/2/2005 6:05	66.33	0.496	134	0.15	134

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	MO-6	**Results Summary**	
Structures within Region	O-25 - O-43 & M-01 - M-47	Number of Events	135
Model ID	MO-6.1	Peak Volume:	42,175,947 ft^3
Structure Type			315.50 MG
PWSA Sewershed		Total Volume:	191,426,623 ft^3
Stream of Discharge			1431.97 MG
NPDES Permit Number		Peak Rate:	2980.26 cfs
Owner			

Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Figure 1 - MO-6 Region CSO Volume

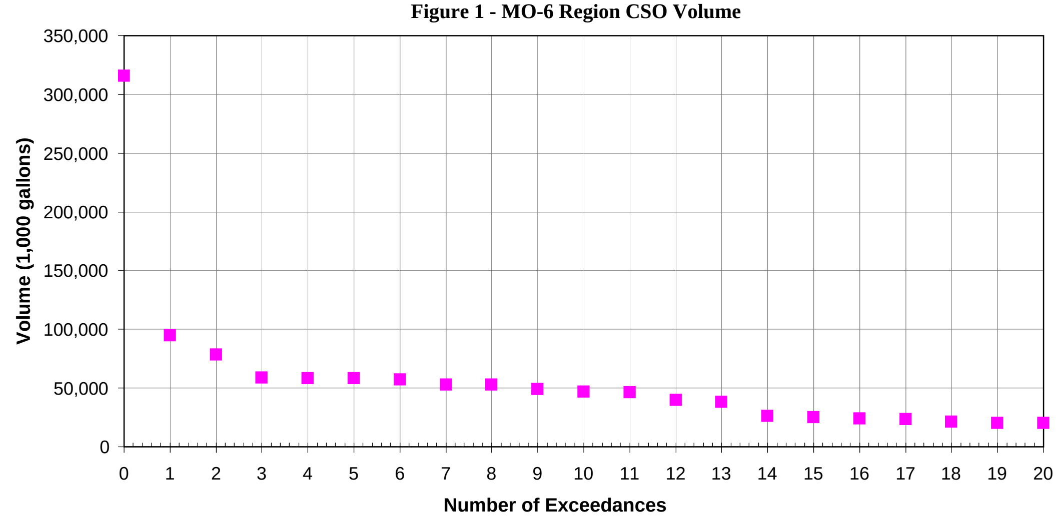
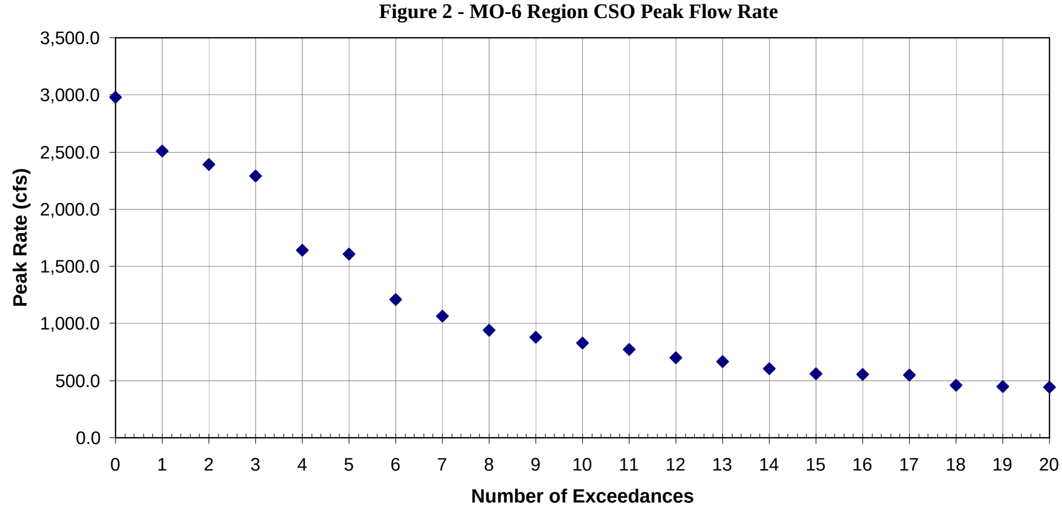


Figure 2 - MO-6 Region CSO Peak Flow Rate



F.3 MONONGAHELA OHIO SUBSYSTEM

Description of Subsystem

The Monongahela – Ohio (MO) Subsystem is located along both the northern and southern sides of the Monongahela River between M-01 and M-47, as well as the northern side of the Ohio River from O-25 through O-43. Control of CSOs within this Subsystem will be based upon Tunnel Storage, in combination with the highest ranked Regional CSO control technologies in the areas not served by the Tunnel. This combination serves to control CSO originating from the following Regions:

- Downtown Monongahela Region (M-01 to M-05)
- Arlington through 25th Region (M-6 to M-18 and M-20 to M-28)
- Second Avenue Region (M-19)
- Boundary Street Region (M-29)
- Hazelwood Region (M-31 to M-40)
- Becks Run Region (M-34)
- Streets Run Region (M-42)
- Nine Mile Run Region (M-47)
- Upper Nine Mile Run (DC175G001/G002 and DC175L001/L002)
- Nine Mile Run-Frick Park (DC129B001, DC128D001/D002/D003 and DC176J001/J002/J003)
- Jacks Run and Woods Run Region (O-25 to O-27)
- Doerr/Superior/Island Aves., Adams Street, Pennsylvania Ave., Dasher Street (O-29 to O-43)
- CSO 030N001 (Part of Becks Run)
- CSO 032N001 (Part of Becks Run)

All of these Regions, and their associated outfalls, currently convey overflows from their respective diversion chambers directly to Becks Run, Streets Run, Nine Mile Run or the Monongahela and Ohio Rivers.

The entire area that is encompassed in this alternative includes approximately 22,800 acres of residential, business and commercial users.

Description of Alternatives

In an effort to determine the most effective combination of controls for this Subsystem, six variations were developed and evaluated. They are labeled MO-1, MO-2, MO-3, MO-4, MO-5 and MO-6. These subsystem variations were based upon a capture level of 4 CSO events per year. A brief description of each is given below.

Alternative MO-1

Alternative MO-1 is based upon Tunnel MO-1, having an approximate length of 12,700 feet. *Attachment 1 – Subsystem Alternative MO-1* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Mon-Ohio system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel MO-1 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 133.02 MG to 32.22 MG for control levels of 0 to 6 overflow events, respectively. *Figure 1 – MO-1 Region CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

Figure 1 - MO-1 Region CSO Volume

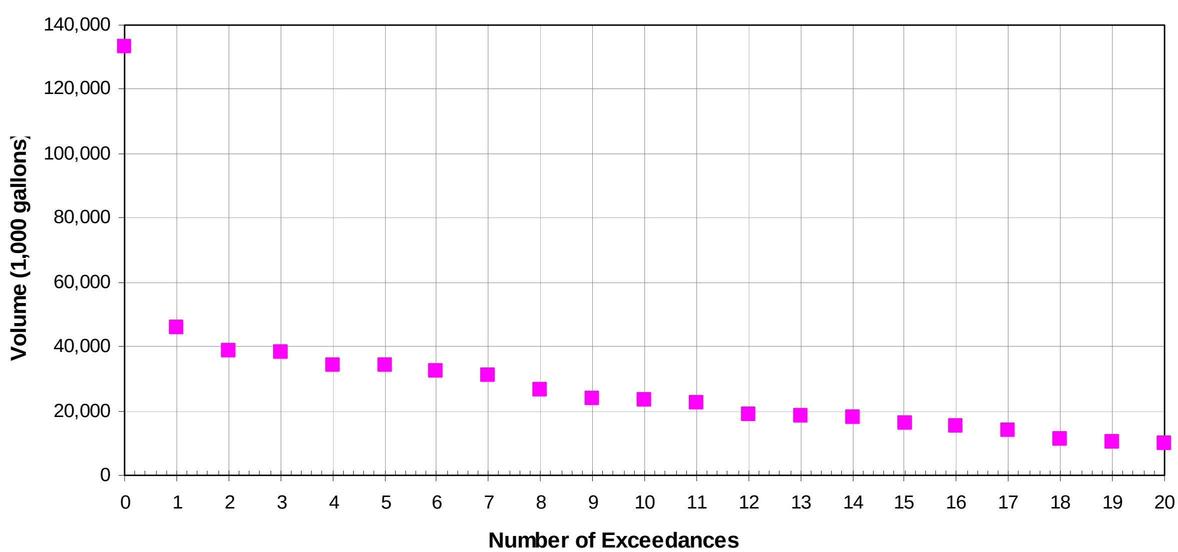


Table 1 - Alternative MO-1 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition

simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 1 - Alternative MO-1 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Jacks Run and Woods Run	O-25 thru O-27	2,701	134	Tunnel MO-1
Dasher Street	O-29 thru O-43	1,101		
Downtown Monongahela	M-1 thru M-5	485		
Arlington through 25th	M-6 to M-18 and M-20 to M-28	858		
2nd Avenue	M-19, M-19A, M-19BCD	902		
Boundary Street	M-29	2,400	65	Surface Storage
Hazelwood	M-31 thru M-40	804	87	Tunnel Storage
Becks Run	M-34	1,681	54	Surface Storage
Streets Run	M-42	7,024	62	Screening & Disinfection
Nine Mile Run	M-47	3,334	45	Screening & Disinfection
Upper Nine Mile Run	DC175G001/G002 and DC175L001/L002	662	61	Sub-Surface Storage
Nine Mile Run-Frick Park	DC129B001, DC128D001/D002/D003 and DC176J001/J002/J003	777	4	Sub-Surface Storage
Outfall (Becks Run)	CSO 030N001	11	19	Sewer Separation
Outfall (Becks Run)	CSO 032N001	44	26	Sub-Surface Storage

Tunnel MO-1

The Monongahela-Ohio Tunnel MO-1 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-25 to M-19. A pump station will be constructed in the vicinity of O-27 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 133 MGD for 0 overflows to 32 MGD for 6 overflows. Assuming a tunnel length of approximately

2.4 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 24 feet.

Other important components of Tunnel MO-1 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel alignment to convey flow from overflow structures and consolidation sewers to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 2 - Tunnel MO-1 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 2 - Tunnel MO-1 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-1	Near O-27	O-25, O-26, O-27	2997.88	5,585	120
MO-2	Near O-29	O-29, O-30	243.58	1,185	66 to 96
MO-3	Near O-33	O-31, O-32, O-33, 0-34	649.12	1,255	90 to 120
MO-4	Near O-38	O-35, O-36, O-37, O-38	123.84	1,390	48 to 78
MO-5	Near O-41	O-39, O-40, O-41	105.23	1,765	48 to 78
MO-6	Near O-43	O-43	9.41	100	36
MO-7	Near M-10	M-6, M-7, M-8, M-10, M-11	244.45	3,015	66 to 96
MO-8	Near M-16	M-12, M-13, M-14, M-14A, M-15, M-16, M-17	271.82	4,190	66 to 108
MO-9	Near M-21	M-18, M-20, M-21, M-22, M-23	156.47	2,250	48 to 90

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-10	Near M-26	M-24, M-26, M-27, M-28	253.56	2,210	66 to 108
MO-13	Near M-01	M-01	13.55	N/A	N/A
MO-14	Near M-02	M-02	3.88	N/A	N/A
MO-15	Near M-03	M-03	81.52	N/A	N/A
MO-16	Near M-03A	M-03A	7.43	N/A	N/A
MO-17	Near M-04	M-04	16.59	N/A	N/A
MO-18	Near M-05	M-05	155.04	N/A	N/A
MO-19	Near M-19	M-19, M-19A, M-19BCD	208.04	4,400	66 to 120

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the MO-1 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Ohio and Monongahela Rivers. Approximately 1 acre of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 2 - Subsystem Alternative MO-1, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>Boundary Street Region</u> CSOs from this portion of Alternative MO-1 will be controlled via implementation of Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Surface storage facilities are commonly equipped with an influent pump station, screening and odor control facilities.

<u>Hazelwood Region</u> CSOs from this portion of Alternative MO-1 will be controlled via implementation of Tunnel Storage. Tunnel storage provides temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Tunnel facilities are commonly equipped with a dewatering pump station, screening and odor control facilities.

<u>Becks Run Region</u> CSOs from this portion of Alternative MO-1 will be controlled via implementation of Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Surface storage facilities are commonly equipped with an influent pump station, screening and odor control facilities.

<u>Streets Run Region</u> CSOs from this portion of Alternative MO-1 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

<u>Nine Mile Run Region</u> CSOs from this portion of Alternative MO-1 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

<u>Upper Nine Mile Run Region</u> CSO from this portion of Alternative MO-1 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

<u>Nine Mile Run - Frick Park</u> CSO from this portion of Alternative MO-1 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage

facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

CSO 030N001 CSO from this portion of Alternative MO-1 will be controlled via Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall.

CSO 032N001 CSO from this portion of Alternative MO-1 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific or the Regional Analysis appendices.

Alternative MO-2

Alternative MO-2 is based upon Tunnel MO-2, having an approximate length of 15,300 feet. *Attachment 3 – Subsystem Alternative MO-2* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Mon-Ohio system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel MO-2 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 271.89 MG to 48.14 MG for control levels of 0 to 6 overflow events, respectively. *Figure 2 – MO-2 Region CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

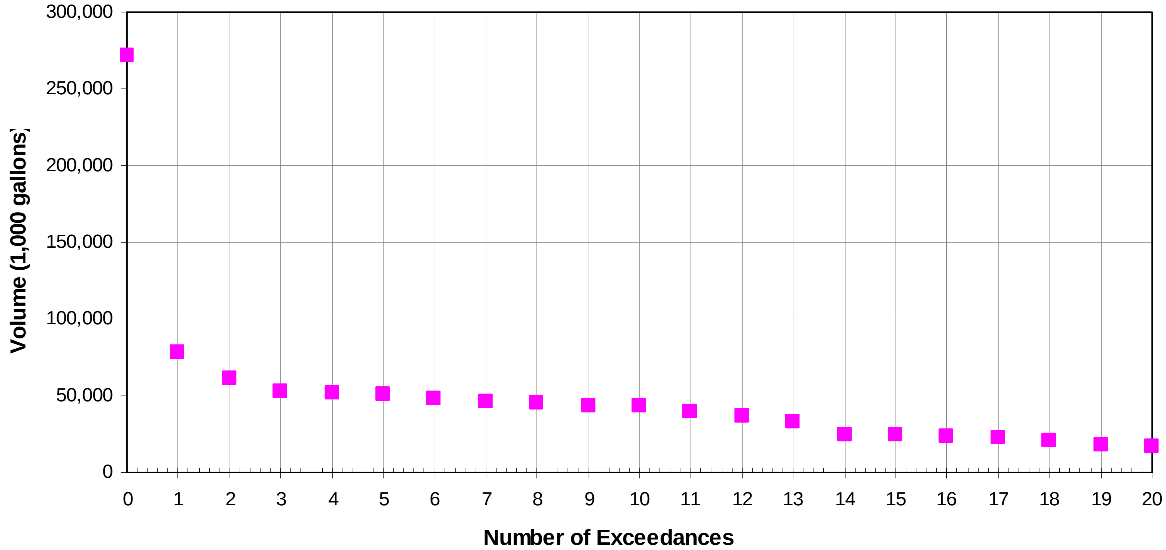


Figure 2 - MO-2 Region CSO Volume

Table 3 - Alternative MO-2 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 3 - Alternative MO-2 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Jacks Run and Woods Run	O-25 thru O-27	2,701	134	Tunnel MO-2
Dasher Street	O-29 thru O-43	1,101		
Downtown Monongahela	M-1 thru M-5	485		
Arlington through 25th	M-6 to M-18 and M-20 to M-28	858		
2nd Avenue	M-19, M-19A, M-19BCD	902		
Boundary Street	M-29	2,400		
Hazelwood	M-31 thru M-40	804	87	Tunnel Storage
Becks Run	M-34	1,681	54	Surface Storage
Streets Run	M-42	7,024	62	Screening & Disinfection
Nine Mile Run	M-47	3,334	45	Screening & Disinfection

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Upper Nine Mile Run	DC175G001/G002 and DC175L001/L002	662	61	Sub-Surface Storage
Nine Mile Run-Frick Park	DC129B001, DC128D001/D002/D003 and DC176J001/J002/J003	777	4	Sub-Surface Storage
Outfall (Becks Run)	CSO 030N001	11	19	Sewer Separation
Outfall (Becks Run)	CSO 032N001	44	26	Sub-Surface Storage

<u>Tunnel MO-2</u>

The Monongahela-Ohio Tunnel MO-2 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-25 to M-29. A pump station will be constructed in the vicinity of O-27 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 272 MGD for 0 overflows to 48 MGD for 6 overflows. Assuming a tunnel length of approximately 2.9 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 27 feet.

Other important components of Tunnel MO-2 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 4 - Alternative MO-2 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 4 - Alternative MO-2 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-1	Near O-27	O-25, O-26, O-27	2997.88	5,585	120
MO-2	Near O-29	O-29, O-30	243.58	1,185	66 to 96
MO-3	Near O-33	O-31, O-32, O-33, 0-34	649.12	1,255	90 to 120
MO-4	Near O-38	O-35, O-36, O-37, O-38	123.84	1,390	48 to 78
MO-5	Near O-41	O-39, O-40, O-41	105.23	1,765	48 to 78
MO-6	Near O-43	O-43	9.41	100	36
MO-7	Near M-10	M-6, M-7, M-8, M-10, M-11	244.45	3,015	66 to 96
MO-8	Near M-16	M-12, M-13, M-14, M-14A, M-15, M-16, M-17	271.82	4,190	66 to 108
MO-9	Near M-21	M-18, M-20, M-21, M-22, M-23	156.47	2,250	48 to 90
MO-10	Near M-26	M-24, M-26, M-27, M-28	253.56	2,210	66 to 108
MO-13	Near M-01	M-01	13.55	N/A	N/A
MO-14	Near M-02	M-02	3.88	N/A	N/A
MO-15	Near M-03	M-03	81.52	N/A	N/A
MO-16	Near M-03A	M-03A	7.43	N/A	N/A
MO-17	Near M-04	M-04	16.59	N/A	N/A
MO-18	Near M-05	M-05	155.04	N/A	N/A
MO-19	Near M-19	M-19, M-19A, M-19BCD	208.04	4,400	66 to 120
MO-20	Near M-29	M-29	863.07	N/A	N/A

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the MO-2 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Ohio and Monongahela Rivers. Approximately 1.5 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 4 - Subsystem Alternative MO-2, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>Hazelwood Region</u> CSOs from this portion of Alternative MO-2 will be controlled via implementation of Tunnel Storage. This tunnel segment would serve as a storage and conveyance spur to MO-2. A conveyance tunnel is preferred over consolidation sewers for this particular region because the pipeline would need to be 30-feet in diameter to accommodate flows associated with 0 events / year. Tunnel storage provides temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Tunnel facilities are commonly equipped with a dewatering pump station, screening and odor control facilities.

A secondary consideration would be to implement the second highest rated alternative for the region. This alternative would be the construction of a sub-surface storage facility in lieu of the storage / conveyance tunnel. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

<u>Becks Run Region</u> CSOs from this portion of Alternative MO-2 will be controlled via implementation of Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Surface storage facilities are commonly equipped with an influent pump station, screening and odor control facilities.

<u>Streets Run Region</u> CSOs from this portion of Alternative MO-2 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly

reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

Nine Mile Run Region CSOs from this portion of Alternative MO-2 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

Upper Nine Mile Run Region CSO from this portion of Alternative MO-2 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Nine Mile Run - Frick Park CSO from this portion of Alternative MO-2 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

CSO 030N001 CSO from this portion of Alternative MO-2 will be controlled via Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall.

CSO 032N001 CSO from this portion of Alternative MO-2 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific or the Regional Analysis appendices.

Alternative MO-3

Alternative MO-3 is based upon Tunnel MO-3, having an approximate length of 28,500 feet. *Attachment 5 – Subsystem Alternative MO-3* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Mon-Ohio system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel MO-3 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 331.62 MG to 57.87 MG for control levels of 0 to 6 overflow events, respectively. *Figure 3 – MO-3Region CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

Figure 3 - MO-3 Region CSO Volume

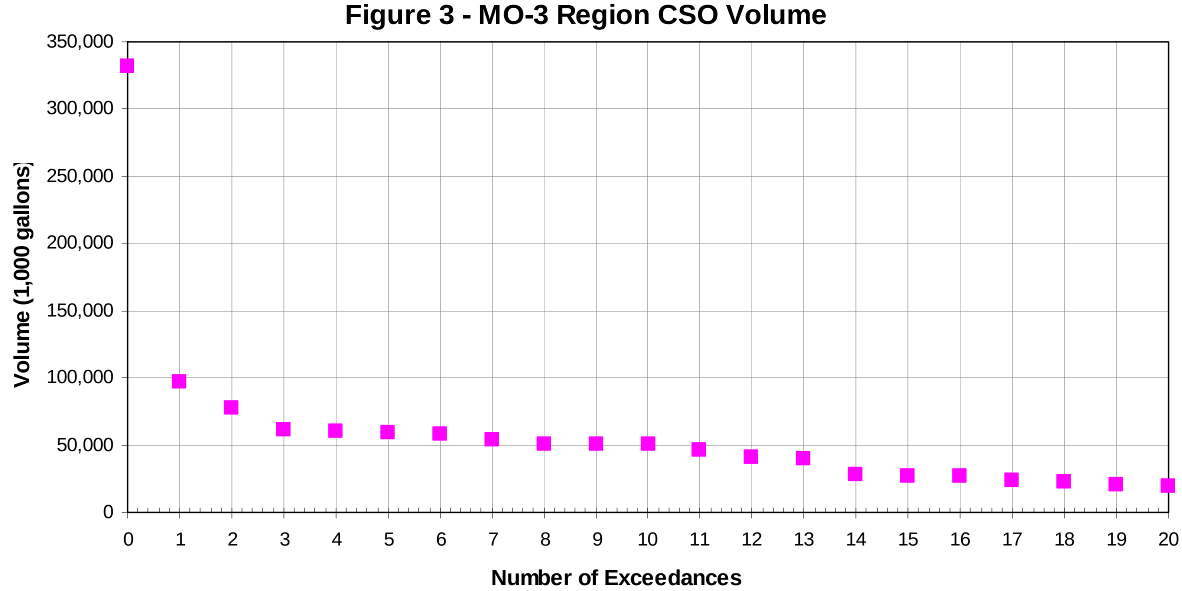


Table5 - Alternative MO-3 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition

simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 5 - Alternative MO-3 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Jacks Run and Woods Run	O-25 thru O-27	2,701	135	Tunnel MO-3
Dasher Street	O-29 thru O-43	1,101		
Downtown Monongahela	M-1 thru M-5	485		
Arlington through 25th	M-6 to M-18 and M-20 to M-28	858		
2nd Avenue	M-19, M-19A, M-19BCD	902		
Boundary Street	M-29	2,400		
Hazelwood	M-31 thru M-40	804		
Becks Run	M-34	1,681		
Streets Run	M-42	7,024	62	Screening & Disinfection
Nine Mile Run	M-47	3,334	45	Screening & Disinfection
Upper Nine Mile Run	DC175G001/G002 and DC175L001/L002	662	61	Sub-Surface Storage
Nine Mile Run-Frick Park	DC129B001, DC128D001/D002/D003 and DC176J001/J002/J003	777	4	Sub-Surface Storage
Outfall (Becks Run)	CSO 030N001	11	19	Sewer Separation
Outfall (Becks Run)	CSO 032N001	44	26	Sub-Surface Storage

<u>Tunnel MO-3</u>

The Monongahela-Ohio Tunnel MO-3 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-25 to M-40. A pump station will be constructed in the vicinity of O-27 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 332 MGD for 0 overflows to 58 MGD for 6 overflows. Assuming a tunnel length of approximately

5.4 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 21 feet.

Other important components of Tunnel MO-3 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 6 - Alternative MO-3 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 6 - Alternative MO-3 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-1	Near O-27	O-25, O-26, O-27	2997.88	5,585	120
MO-2	Near O-29	O-29, O-30	243.58	1,185	66 to 96
MO-3	Near O-33	O-31, O-32, O-33, 0-34	649.12	1,255	90 to 120
MO-4	Near O-38	O-35, O-36, O-37, O-38	123.84	1,390	48 to 78
MO-5	Near O-41	O-39, O-40, O-41	105.23	1,765	48 to 78
MO-6	Near O-43	O-43	9.41	100	36
MO-7	Near M-10	M-6, M-7, M-8, M-10, M-11	244.45	3,015	66 to 96
MO-8	Near M-16	M-12, M-13, M-14, M-14A, M-15, M-16, M-17	271.82	4,190	66 to 108
MO-9	Near M-21	M-18, M-20, M-21, M-22, M-23	156.47	2,250	48 to 90

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-10	Near M-26	M-24, M-26, M-27, M-28	253.56	2,210	66 to 108
MO-11	Near M-34	M-34	55.62	100	36 to 66
MO-13	Near M-01	M-01	13.55	N/A	N/A
MO-14	Near M-02	M-02	3.88	N/A	N/A
MO-15	Near M-03	M-03	81.52	N/A	N/A
MO-16	Near M-03A	M-03A	7.43	N/A	N/A
MO-17	Near M-04	M-04	16.59	N/A	N/A
MO-18	Near M-05	M-05	155.04	N/A	N/A
MO-19	Near M-19	M-19, M-19A, M-19BCD	208.04	4,400	66 to 120
MO-20	Near M-29	M-29	863.07	N/A	N/A
MO-21	Near M-31	M-31	21.93	N/A	N/A
MO-22	Near M-32	M-32	13.74	N/A	N/A
MO-23	Near M-33	M-33	8.4	N/A	N/A
MO-24	Near M-35	M-35	55.25	N/A	N/A
MO-25	Near M-36	M-36	93.27	N/A	N/A
MO-26	Near M-37	M-37	18.55	N/A	N/A
MO-27	Near M-38	M-38	3.67	N/A	N/A
MO-28	Near M-39	M-39	9.59	N/A	N/A
MO-29	Near M-40	M-40	60.65	N/A	N/A

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the MO-3 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Ohio and Monongahela Rivers. Approximately 1.5 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 6 - Subsystem Alternative MO-3, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>Streets Run Region</u> CSOs from this portion of Alternative MO-3 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

<u>Nine Mile Run Region</u> CSOs from this portion of Alternative MO-3 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

<u>Upper Nine Mile Run Region</u> CSO from this portion of Alternative MO-3 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

<u>Nine Mile Run - Frick Park</u> CSO from this portion of Alternative MO-3 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

<u>CSO 030N001</u> CSO from this portion of Alternative MO-3 will be controlled via Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall.

CSO 032N001 CSO from this portion of Alternative MO-3 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific or the Regional Analysis appendices.

Alternative MO-4

Alternative MO-4 is based upon Tunnel MO-4, having an approximate length of 32,200 feet. *Attachment 7 – Subsystem Alternative MO-4* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Mon-Ohio system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel MO-4 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 376.48 MG to 63.32 MG for control levels of 0 to 6 overflow events, respectively. *Figure 4 – MO-4 Regional CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

Figure 4 - MO-4 Region CSO Volume

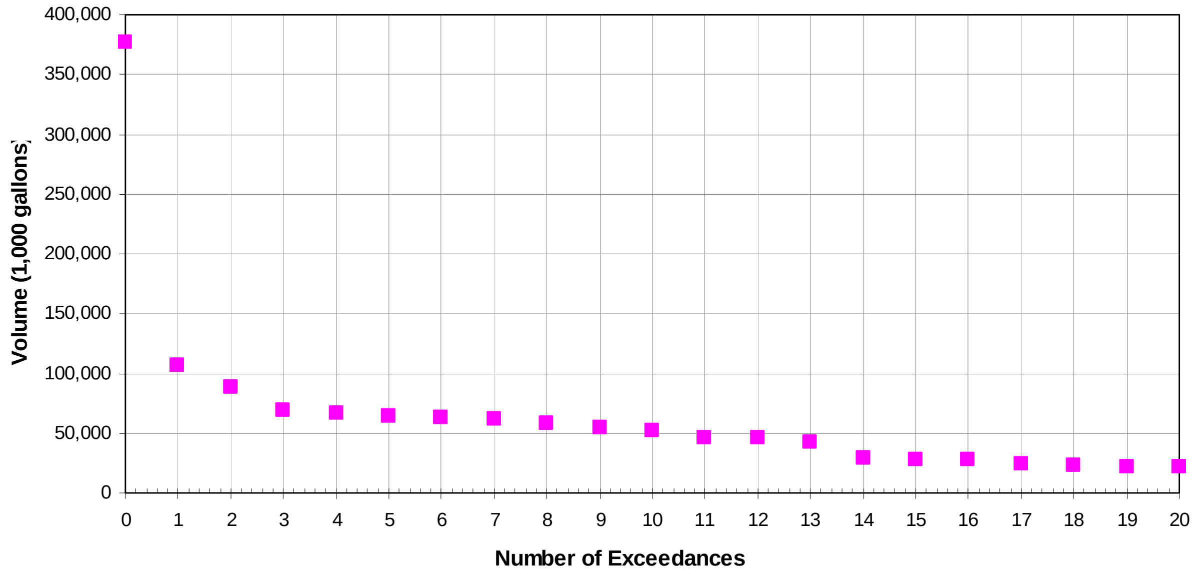


Table 7 - Alternative MO-4 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 7 - Alternative MO-4 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Jacks Run and Woods Run	O-25 thru O-27	2,701	137	Tunnel MO-4
Dasher Street	O-29 thru O-43	1,101		
Downtown Monongahela	M-1 thru M-5	485		
Arlington through 25th	M-6 to M-18 and M-20 to M-28	858		
2nd Avenue	M-19, M-19A, M-19BCD	902		
Boundary Street	M-29	2,400		
Hazelwood	M-31 thru M-40	804		
Becks Run	M-34	1,681		
Streets Run	M-42	7,024		
Nine Mile Run	M-47	3,334	45	Screening & Disinfection
Upper Nine Mile Run	DC175G001/G002 and DC175L001/L002	662	61	Sub-Surface Storage

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Nine Mile Run-Frick Park	DC129B001, DC128D001/D002/D003 and DC176J001/J002/J003	777	4	Sub-Surface Storage
Outfall (Becks Run)	CSO 030N001	11	19	Sewer Separation
Outfall (Becks Run)	CSO 032N001	44	26	Sub-Surface Storage

<u>Tunnel MO-4</u>

The Monongahela-Ohio Tunnel MO-4 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-25 to M-42. A pump station will be constructed in the vicinity of O-27 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 377 MGD for 0 overflows to 63.5 MGD for 6 overflows. Assuming a tunnel length of approximately 6.1 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 21 feet.

Other important components of Tunnel MO-4 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 8 - Alternative MO-4 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 8 - Alternative MO-4 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-1	Near O-27	O-25, O-26, O-27	2997.88	5,585	120
MO-2	Near O-29	O-29, O-30	243.58	1,185	66 to 96
MO-3	Near O-33	O-31, O-32, O-33, 0-34	649.12	1,255	90 to 120
MO-4	Near O-38	O-35, O-36, O-37, O-38	123.84	1,390	48 to 78
MO-5	Near O-41	O-39, O-40, O-41	105.23	1,765	48 to 78
MO-6	Near O-43	O-43	9.41	100	36
MO-7	Near M-10	M-6, M-7, M-8, M-10, M-11	244.45	3,015	66 to 96
MO-8	Near M-16	M-12, M-13, M-14, M-14A, M-15, M-16, M-17	271.82	4,190	66 to 108
MO-9	Near M-21	M-18, M-20, M-21, M-22, M-23	156.47	2,250	48 to 90
MO-10	Near M-26	M-24, M-26, M-27, M-28	253.56	2,210	66 to 108
MO-11	Near M-34	M-34	55.62	100	36 to 66
MO-12	Near M-42	M-42	70.27	11,755	36 to 66
MO-13	Near M-01	M-01	13.55	N/A	N/A
MO-14	Near M-02	M-02	3.88	N/A	N/A
MO-15	Near M-03	M-03	81.52	N/A	N/A
MO-16	Near M-03A	M-03A	7.43	N/A	N/A
MO-17	Near M-04	M-04	16.59	N/A	N/A
MO-18	Near M-05	M-05	155.04	N/A	N/A
MO-19	Near M-19	M-19, M-19A, M-19BCD	208.04	4,400	66 to 120
MO-20	Near M-29	M-29	863.07	N/A	N/A
MO-21	Near M-31	M-31	21.93	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-22	Near M-32	M-32	13.74	N/A	N/A
MO-23	Near M-33	M-33	8.4	N/A	N/A
MO-24	Near M-35	M-35	55.25	N/A	N/A
MO-25	Near M-36	M-36	93.27	N/A	N/A
MO-26	Near M-37	M-37	18.55	N/A	N/A
MO-27	Near M-38	M-38	3.67	N/A	N/A
MO-28	Near M-39	M-39	9.59	N/A	N/A
MO-29	Near M-40	M-40	60.65	N/A	N/A

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the MO-4 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Ohio and Monongahela Rivers. Approximately 2 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 8 - Subsystem Alternative MO-4, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>Nine Mile Run Region</u> CSOs from this portion of Alternative MO-4 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

<u>Upper Nine Mile Run Region</u> CSO from this portion of Alternative MO-4 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage

facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

<u>Nine Mile Run - Frick Park</u> CSO from this portion of Alternative MO-4 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

<u>CSO 030N001</u> CSO from this portion of Alternative MO-4 will be controlled via Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall.

<u>CSO 032N001</u> CSO from this portion of Alternative MO-4 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific or the Regional Analysis appendices.

Alternative MO-5

Alternative MO-5 is based upon Tunnel MO-5, having an approximate length of 39,700 feet. *Attachment 9 – Subsystem Alternative MO-5* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Mon-Ohio system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel MO-5 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 420.11 MG to 71.18 MG for control levels of 0 to 6 overflow events, respectively. *Figure 5 – MO-5 Region CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

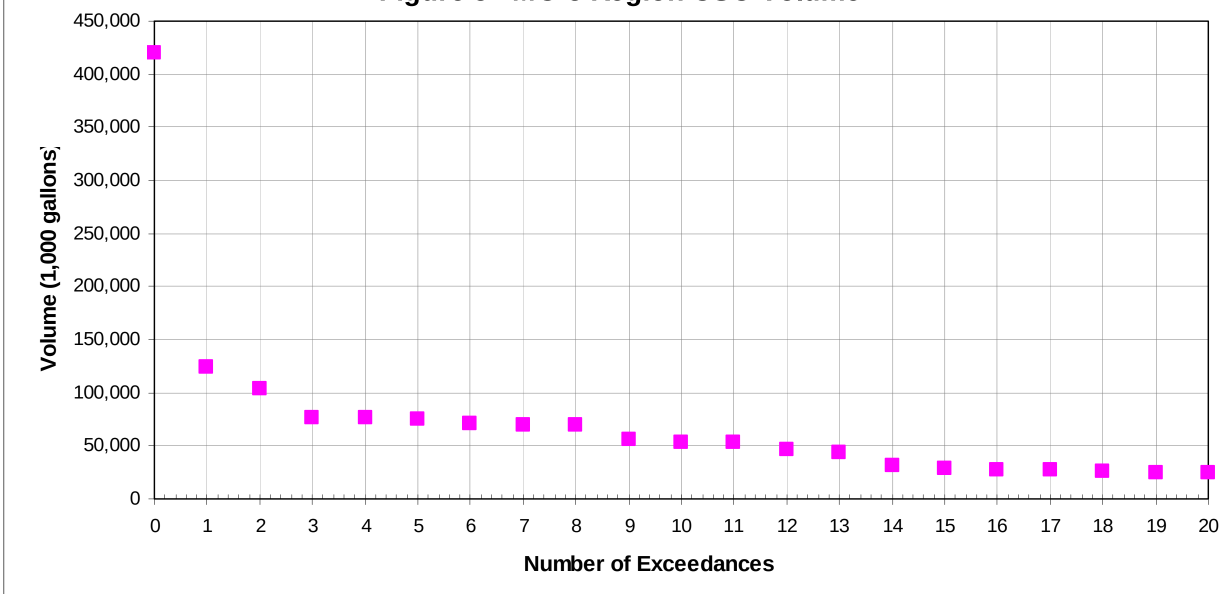


Figure 5 - MO-5 Region CSO Volume

Table 9 - Alternative MO-5 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 9 - Alternative MO-5 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Jacks Run and Woods Run	O-25 thru O-27	2,701	137	Tunnel MO-5
Dasher Street	O-29 thru O-43	1,101		
Downtown Monongahela	M-1 thru M-5	485		
Arlington through 25th	M-6 to M-18 and M-20 to M-28	858		
2nd Avenue	M-19, M-19A, M-19BCD	902		
Boundary Street	M-29	2,400		
Hazelwood	M-31 thru M-40	804		
Becks Run	M-34	1,681		
Streets Run	M-42	7,024		
Nine Mile Run	M-47	3,334		
Upper Nine Mile Run	DC175G001/G002 and DC175L001/L002	662	61	Sub-Surface Storage
Nine Mile Run-Frick Park	DC129B001, DC128D001/D002/D003 and DC176J001/J002/J003	777	4	Sub-Surface Storage
Outfall (Becks Run)	CSO 030N001	11	19	Sewer Separation
Outfall (Becks Run)	CSO 032N001	44	26	Sub-Surface Storage

Tunnel MO-5

The Monongahela-Ohio Tunnel MO-5 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-25 to M-47. A pump station will be constructed in the vicinity of O-27 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 420 MGD for 0 overflows to 71 MGD for 6 overflows. Assuming a tunnel length of approximately 7.5 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 20 feet.

Other important components of Tunnel MO-5 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 10 - Alternative MO-5 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 10 - Alternative MO-5 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-1	Near O-27	O-25, O-26, O-27	2997.88	5,585	120
MO-2	Near O-29	O-29, O-30	243.58	1,185	66 to 96
MO-3	Near O-33	O-31, O-32, O-33, 0-34	649.12	1,255	90 to 120
MO-4	Near O-38	O-35, O-36, O-37, O-38	123.84	1,390	48 to 78
MO-5	Near O-41	O-39, O-40, O-41	105.23	1,765	48 to 78
MO-6	Near O-43	O-43	9.41	100	36
MO-7	Near M-10	M-6, M-7, M-8, M-10, M-11	244.45	3,015	66 to 96
MO-8	Near M-16	M-12, M-13, M-14, M-14A, M-15, M-16, M-17	271.82	4,190	66 to 108
MO-9	Near M-21	M-18, M-20, M-21, M-22, M-23	156.47	2,250	48 to 90
MO-10	Near M-26	M-24, M-26, M-27, M-28	253.56	2,210	66 to 108
MO-11	Near M-34	M-34	55.62	100	36 to 66
MO-12	Near M-42	M-42	70.27	11,755	36 to 66
MO-13	Near M-01	M-01	13.55	N/A	N/A

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-14	Near M-02	M-02	3.88	N/A	N/A
MO-15	Near M-03	M-03	81.52	N/A	N/A
MO-16	Near M-03A	M-03A	7.43	N/A	N/A
MO-17	Near M-04	M-04	16.59	N/A	N/A
MO-18	Near M-05	M-05	155.04	N/A	N/A
MO-19	Near M-19	M-19, M-19A, M-19BCD	208.04	4,400	66 to 120
MO-20	Near M-29	M-29	863.07	N/A	N/A
MO-21	Near M-31	M-31	21.93	N/A	N/A
MO-22	Near M-32	M-32	13.74	N/A	N/A
MO-23	Near M-33	M-33	8.4	N/A	N/A
MO-24	Near M-35	M-35	55.25	N/A	N/A
MO-25	Near M-36	M-36	93.27	N/A	N/A
MO-26	Near M-37	M-37	18.55	N/A	N/A
MO-27	Near M-38	M-38	3.67	N/A	N/A
MO-28	Near M-39	M-39	9.59	N/A	N/A
MO-29	Near M-40	M-40	60.65	N/A	N/A
MO-30	Near M-47	M-47	47.06	N/A	N/A

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the MO-5 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Ohio and Monongahela Rivers. Approximately 2 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 10 - Subsystem Alternative MO-5, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

Upper Nine Mile Run Region CSO from this portion of Alternative MO-5 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Construction of a consolidation sewer to serve this remote region would cost approximately $30.9MM, which is nearly 450% higher than the cost of the tank. This facility will remain a stand-alone CSO control alternative and will not connect to tunnel MO-5 at M-47.

Nine Mile Run – Frick Park CSO from this portion of Alternative MO-5 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Construction of a consolidation sewer to serve this remote region would cost approximately $12.1MM, which is nearly 150% higher than the cost of the tank. This facility will remain a stand-alone CSO control alternative and will not connect to tunnel MO-5 at M-47.

CSO 030N001 CSO from this portion of Alternative MO-5 will be controlled via Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall.

CSO 032N001 CSO from this portion of Alternative MO-5 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage

facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific or the Regional Analysis appendices.

Alternative MO-6

Alternative MO-6 is based upon Tunnel MO-6, having an approximate length of 26,300 feet. *Attachment 11 – Subsystem Alternative MO-6* illustrates the location of the trunk sewers, outfalls, regulators, and overall tributary area. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows in the Mon-Ohio system will be controlled using the highest ranked CSO control technologies that were identified during the Regional Alternatives Evaluation process. Detailed descriptions of these Regional Alternatives may be found in Appendices D and E.

Tunnel MO-6 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) that ranges from 315.48 MG to 57.06 MG for control levels of 0 to 6 overflow events, respectively. *Figure 6 – MO-6 Region CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

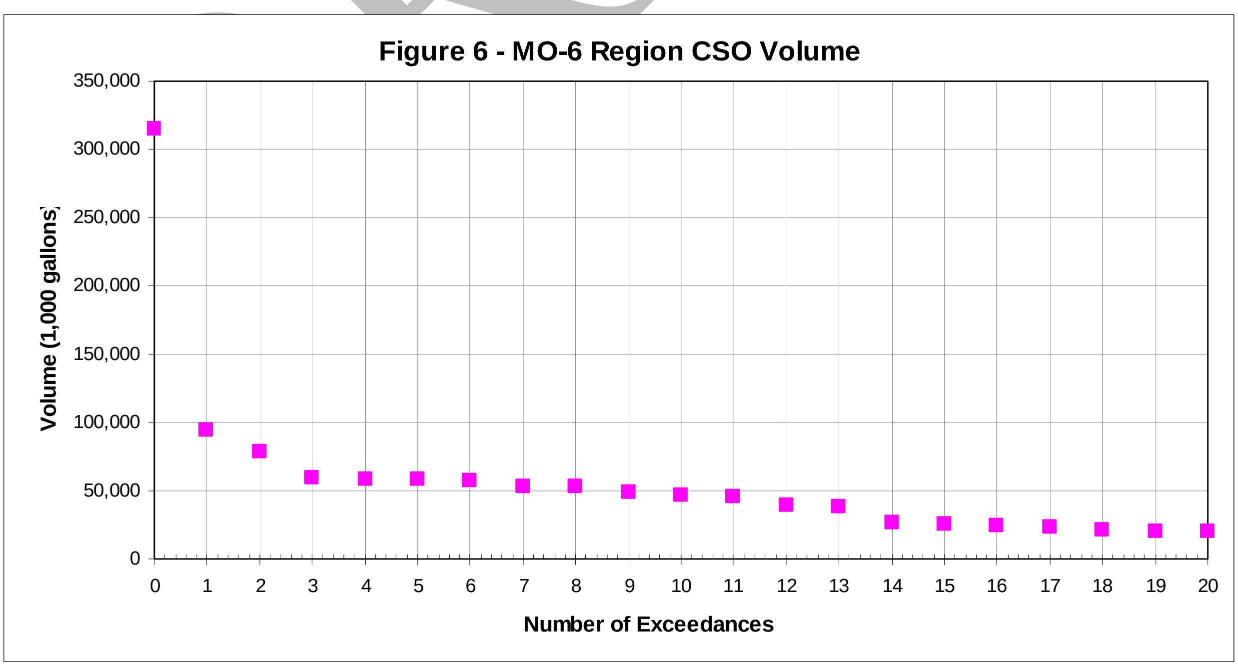


Table 11- Alternative MO-6 Characteristics summarizes the number of overflow events experienced by each component of this alternative during the Typical Year Baseline Condition simulation, as well as the sewershed characteristics and the highest ranked CSO control technology for all applicable Regions not controlled by the tunnel.

Table 11 - Alternative MO-6 Characteristics

Outfall Grouping / Region	Outfalls	Area (Acres)	No. of Overflow Events	CSO Control Technology
Jacks Run and Woods Run	O-25 thru O-27	2,701	135	Tunnel MO-6
Dasher Street	O-29 thru O-43	1,101		
Downtown Monongahela	M-1 thru M-5	485		
Arlington through 25th	M-6 to M-18 and M-20 to M-28	858		
2nd Avenue	M-19, M-19A, M-19BCD	902		
Boundary Street	M-29	2400		
Hazelwood	M-31 thru M-40	804	87	Tunnel Storage
Becks Run	M-34	1,681	54	Surface Storage
Streets Run	M-42	7,024	62	Screening & Disinfection
Nine Mile Run	M-47	3,334	45	Tunnel MO-6
Upper Nine Mile Run	DC175G001/G002 and DC175L001/L002	662	61	Sub-Surface Storage
Nine Mile Run-Frick Park	DC129B001, DC128D001/D002/D003 and DC176J001/J002/J003	777	4	Sub-Surface Storage
Outfall (Becks Run)	CSO 030N001	11	19	Sewer Separation
Outfall (Becks Run)	CSO 032N001	44	26	Sub-Surface Storage

Tunnel MO-6

The Monongahela-Ohio Tunnel MO-6 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-25 to M-47. A pump station will be constructed in the vicinity of O-27 to dewater the stored volume of water into the ALCOSAN interceptor for transport to the ALCOSAN treatment plant. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement ranging from 315.5 MGD for 0 overflows to 57 MGD for 6 overflows. Assuming a tunnel length of approximately 5.0 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 22 feet.

Other important components of Tunnel MO-6 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnel. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 12 - Alternative MO-6 Consolidation Sewer & Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 12 - Alternative MO-6 Consolidation Sewer & Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-1	Near O-27	O-25, O-26, O-27	2997.88	5,585	120
MO-2	Near O-29	O-29, O-30	243.58	1,185	66 to 96
MO-3	Near O-33	O-31, O-32, O-33, 0-34	649.12	1,255	90 to 120
MO-4	Near O-38	O-35, O-36, O-37, O-38	123.84	1,390	48 to 78
MO-5	Near O-41	O-39, O-40, O-41	105.23	1,765	48 to 78
MO-6	Near O-43	O-43	9.41	100	36
MO-7	Near M-10	M-6, M-7, M-8, M-10, M-11	244.45	3,015	66 to 96
MO-8	Near M-16	M-12, M-13, M-14, M-14A, M-15, M-16, M-17	271.82	4,190	66 to 108

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
MO-9	Near M-21	M-18, M-20, M-21, M-22, M-23	156.47	2,250	48 to 90
MO-10	Near M-26	M-24, M-26, M-27, M-28	253.56	2,210	66 to 108
MO-13	Near M-01	M-01	13.55	N/A	N/A
MO-14	Near M-02	M-02	3.88	N/A	N/A
MO-15	Near M-03	M-03	81.52	N/A	N/A
MO-16	Near M-03A	M-03A	7.43	N/A	N/A
MO-17	Near M-04	M-04	16.59	N/A	N/A
MO-18	Near M-05	M-05	155.04	N/A	N/A
MO-19	Near M-19	M-19, M-19A, M-19BCD	208.04	4,400	66 to 120
MO-20	Near M-29	M-29	863.07	N/A	N/A
MO-30	Near M-47	M-47	47.06	N/A	N/A

There appears to be a limited amount of available space for potential large diameter receiving / extraction pits, a dewatering pump station and ancillary facilities for odor control or coarse screening in close proximity to the MO-6 alignment. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; as well as natural features such as the Ohio and Monongahela Rivers. Approximately 1.5 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 12 - Subsystem Alternative MO-6, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

Hazelwood Region CSOs from this portion of Alternative MO-6 will be controlled via implementation of Tunnel Storage. This tunnel segment would serve as a storage and conveyance spur to MO-6. A conveyance tunnel is preferred over consolidation sewers for this particular region because the pipeline would need to be 30-feet in diameter to accommodate flows associated with 0 events / year. Tunnel storage provides temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Tunnel facilities are commonly equipped with a dewatering pump station, screening and odor control facilities.

A secondary consideration would be to implement the second highest rated alternative for the region. This alternative would be the construction of a sub-surface storage facility in lieu of the storage / conveyance tunnel. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Becks Run Region CSOs from this portion of Alternative MO-6 will be controlled via implementation of Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Surface storage facilities are commonly equipped with an influent pump station, screening and odor control facilities.

Streets Run Region CSOs from this portion of Alternative MO-6 will be controlled via implementation of Screening and Disinfection. Screening and disinfection facilities significantly reduce the quantities of floatables, coarse solids and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control facilities.

Upper Nine Mile Run Region CSO from this portion of Alternative MO-6 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Construction of a consolidation sewer to serve this remote region would cost approximately $30.9MM, which is nearly 450% higher than the cost of the tank. This facility will remain a stand-alone CSO control alternative and will not connect to tunnel MO-6 at M-47.

Nine Mile Run – Frick Park CSO from this portion of Alternative MO-6 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Construction of a consolidation sewer to serve this remote region would cost approximately $12.1MM, which is nearly 150% higher than the cost of the tank. This facility will remain a stand-alone CSO control alternative and will not connect to tunnel MO-6 at M-47.

CSO 030N001 CSO from this portion of Alternative MO-6 will be controlled via Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall.

CSO 032N001 CSO from this portion of Alternative MO-6 will be controlled via implementation of Sub-Surface Storage. Storage facilities provide temporary relief by capturing flows that would otherwise discharge to local receiving waters. The captured CSO will be reintroduced to the ALCOSAN interceptor after the system has equalized. Sub-surface storage facilities are commonly equipped with an effluent pump station, screening and odor control facilities.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific or the Regional Analysis appendices.

Alternative Evaluation Results

Table 13 – Monongahela / Ohio Subsystem Alternative Costs, illustrates the planning level capital, O&M and present worth costs associated with alternatives MO-1 through MO-6, when sized for 4 untreated overflow events per year.

Table 13 - Monongahela / Ohio Subsystem Alternative Costs

Subsystem	Capital Cost (MM$)	Annual O&M Cost (MM$)	PW Cost (MM$)
MO-1	$478.2	$4.4	$529.3
MO-2	$441.4	$4.2	$489.2
MO-3	$420.7	$3.9	$464.9
MO-4	$435.0	$4.0	$479.8
MO-5	$458.5	$4.2	$505.8
MO-6	$438.4	$4.2	$486.9

For the purpose of this Feasibility Study, the above alternatives were further evaluated based on a combination of their economic, environmental, implementation, and operational impacts over a range of CSO control levels corresponding to 4 untreated overflows per year.

Attachment 13 – Monongahela / Ohio Subsystem Alternatives Scoring Sheet illustrates the composite scoring of economic, environmental, implementation, and operational evaluation factors for control levels of 4 overflows per year. Complete details of the economic evaluation and the composite scoring of economic, environmental, implementation, and operational evaluation factors can be found in Appendix F.

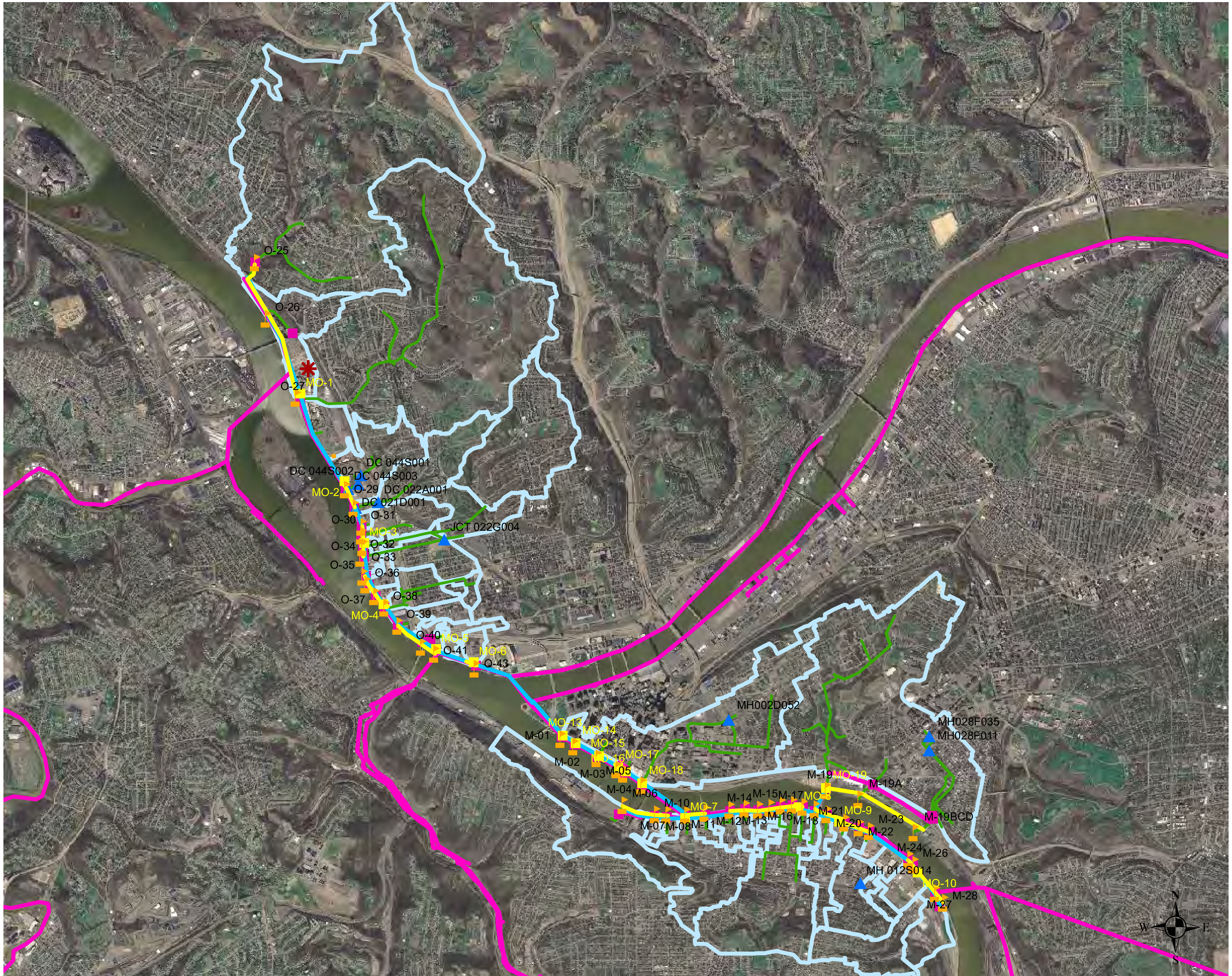
Recommendations

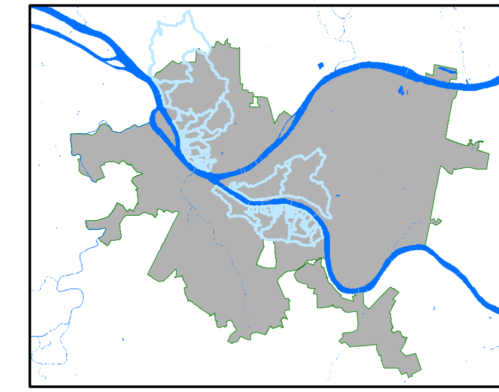
It is recommended that the following alternative be carried forward as part of the overall System-Wide alternative.

- MO-5. This alternative resulted in the highest score for control level of 4 events per year.

Significant Issues

Some issues exist with the siting of a tunnel. It appears that there is some space for the facilities associated with the tunnel, however, there is significant infrastructure at intermittent locations along the entire length of the tunnel alignment. Detailed geotechnical studies would have to be completed to determine the suitability of the underlying subsurface conditions for tunnel construction. In addition, construction of the drop shafts and consolidation sewers will be a significant endeavor considering the congested infrastructure and natural features that exist in the areas where the sewers would be constructed. In addition to detailed geotechnical studies, permitting and land acquisition would determine the final location of these facilities if this alternative is selected for implementation. Issues associated with the outlier outfalls are presented in the Outfall Specific or the Regional Analysis appendices.





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel MO-1
- Consolidation Pipe
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

4,000 0 4,000 Feet

Attachment 1
Subsystem Alternative MO-1 Tunnel Portion

CSO Control Alternatives

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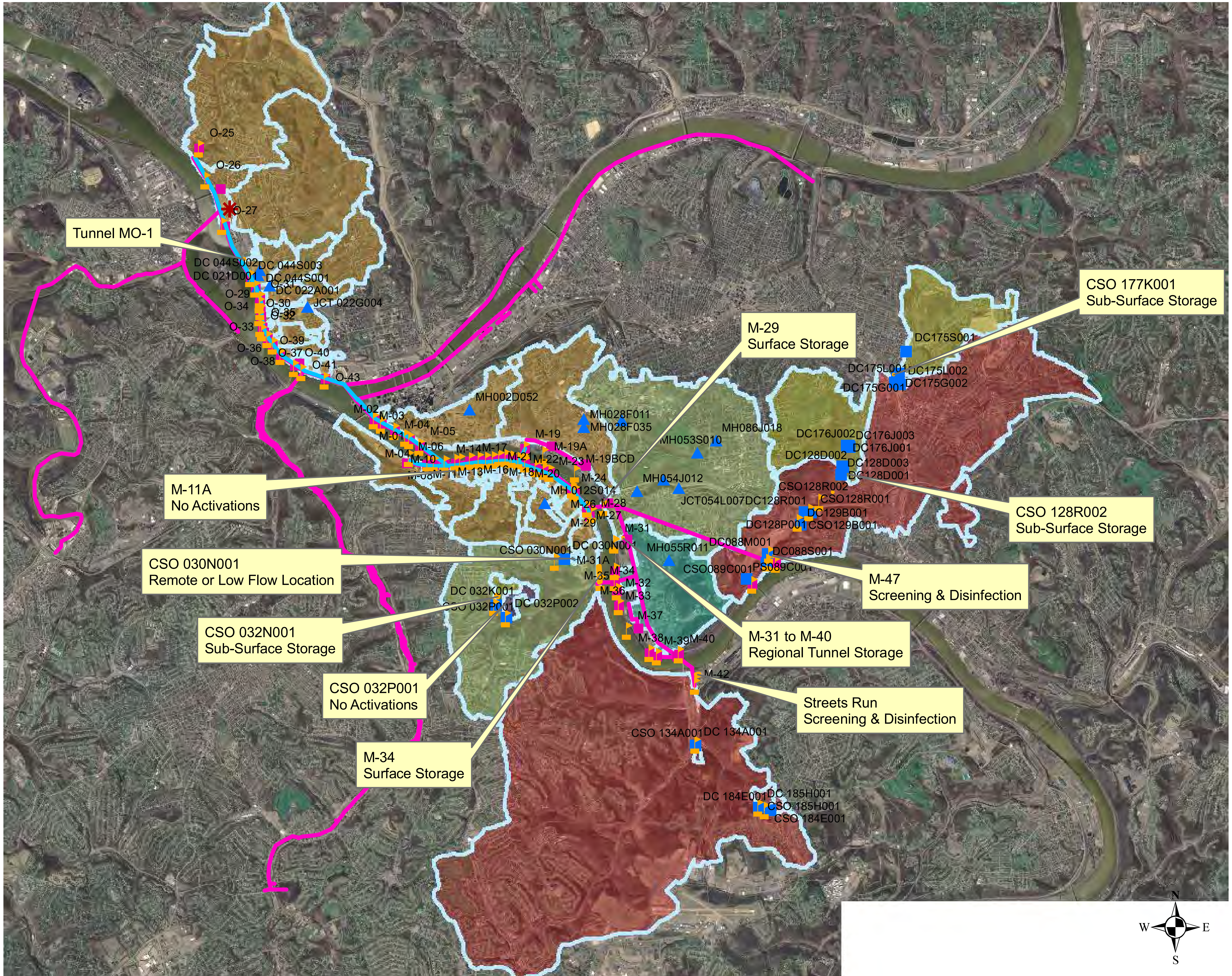

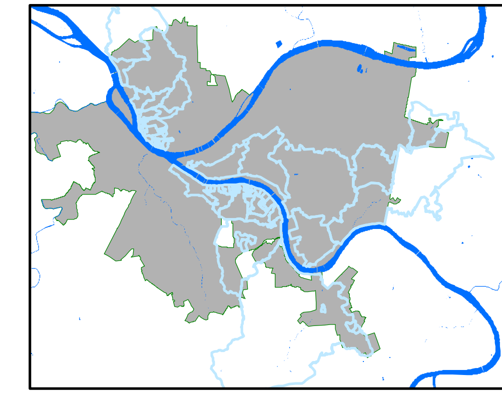

Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Surface Storage
- Screening & Disinfection
- Sub-Surface Storage
- Regional Tunnel Storage
- No Activations
- Remote or Low Flow Location
- Tunnel MO-1
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Combined Sewer Outfall

5,000 0 5,000 10,000 Feet

Attachment 2 Subsystem Alternative MO-1

CSO Control Alternatives

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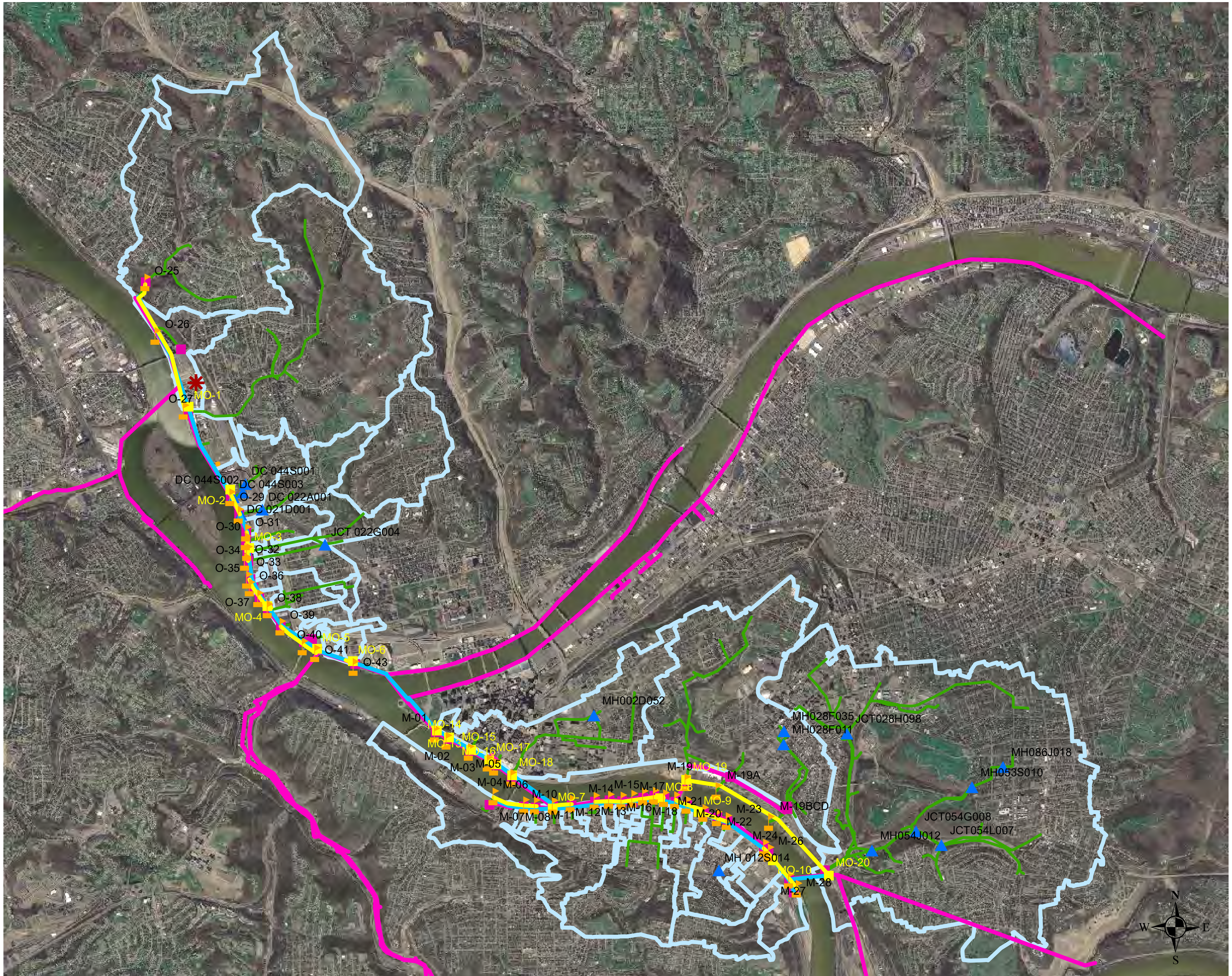

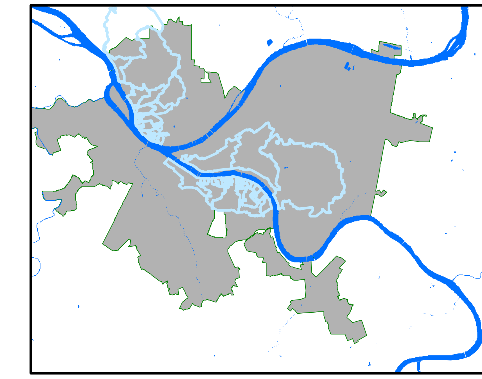

Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel MO-2
- Consolidation Pipe
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

5,000 0 5,000 Feet

Attachment 3 Subsystem Alternative MO-2 Tunnel Portion

CSO Control Alternatives

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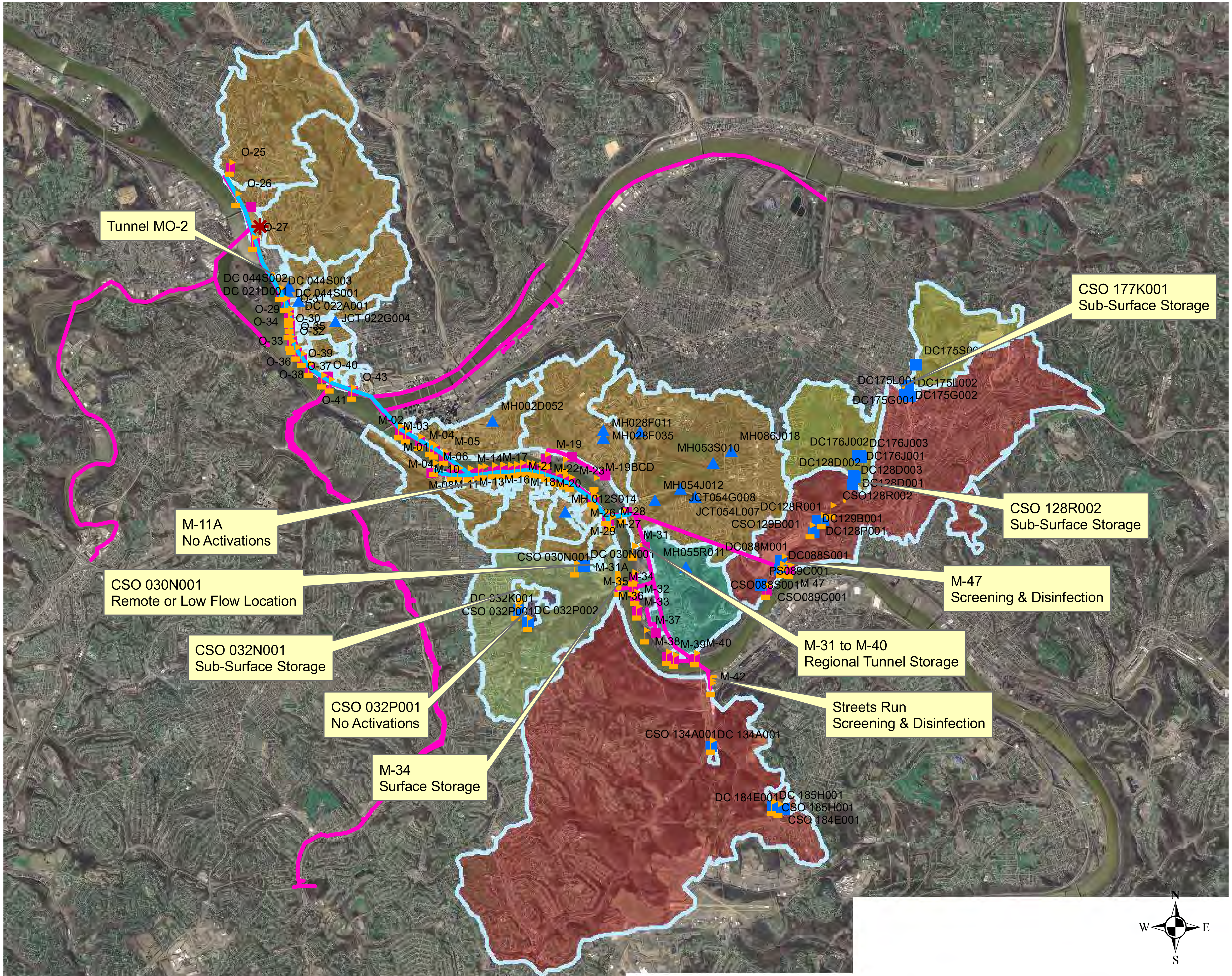

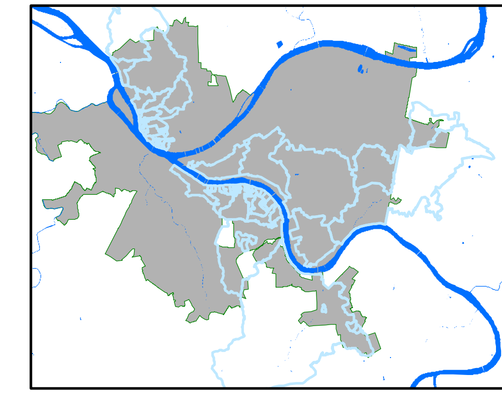

Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Surface Storage
- Screening & Disinfection
- Sub-Surface Storage
- Regional Tunnel Storage
- No Activations
- Remote or Low Flow Location
- Tunnel MO-2
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Combined Sewer Outfall

5,000 0 5,000 10,000 Feet

Attachment 4 Subsystem Alternative MO-2

CSO Control Alternatives

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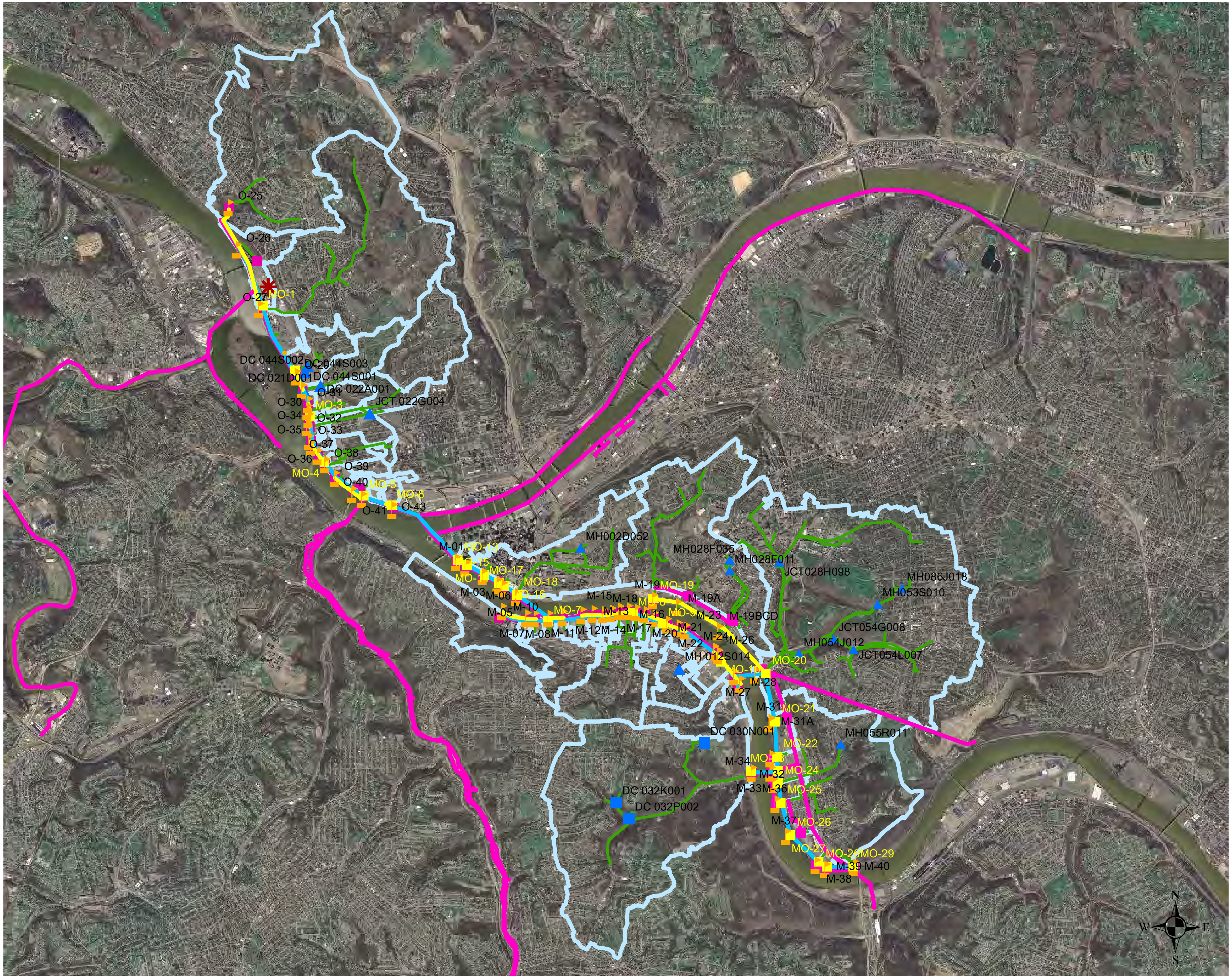

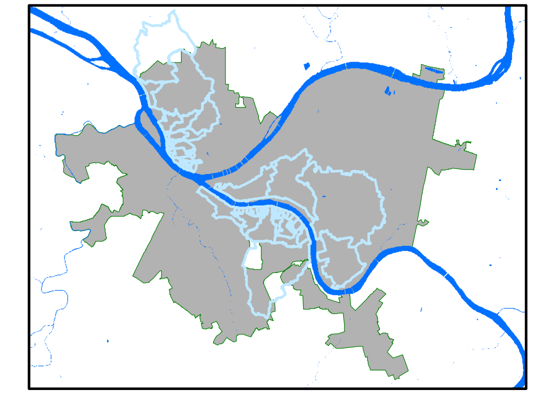

Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel MO-3
- Consolidation Pipe
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

5,000 0 5,000 Feet

Attachment 5 Subsystem Alternative MO-3 Tunnel Portion

CSO Control Alternatives

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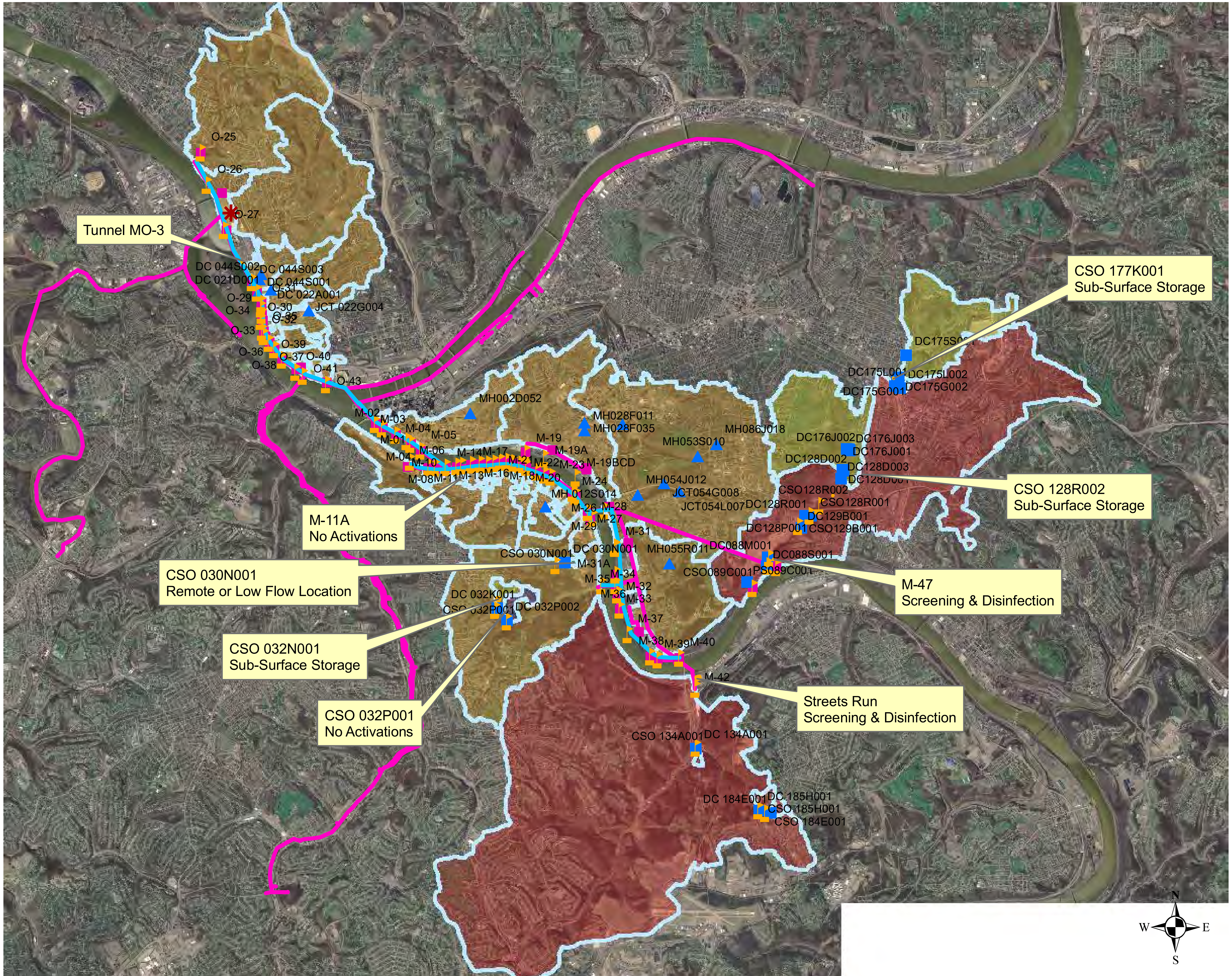
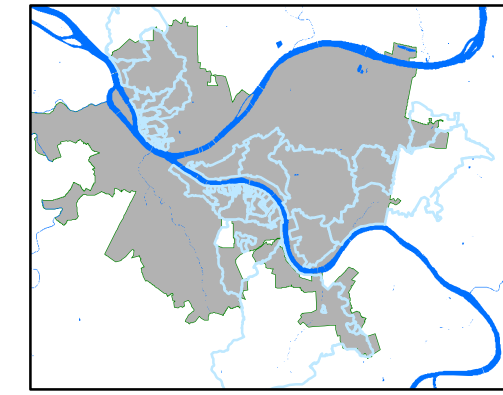
ATTACHMENT C - APPENDIX F





Attachment 6
Subsystem
Alternative MO-3

CSO Control Alternatives

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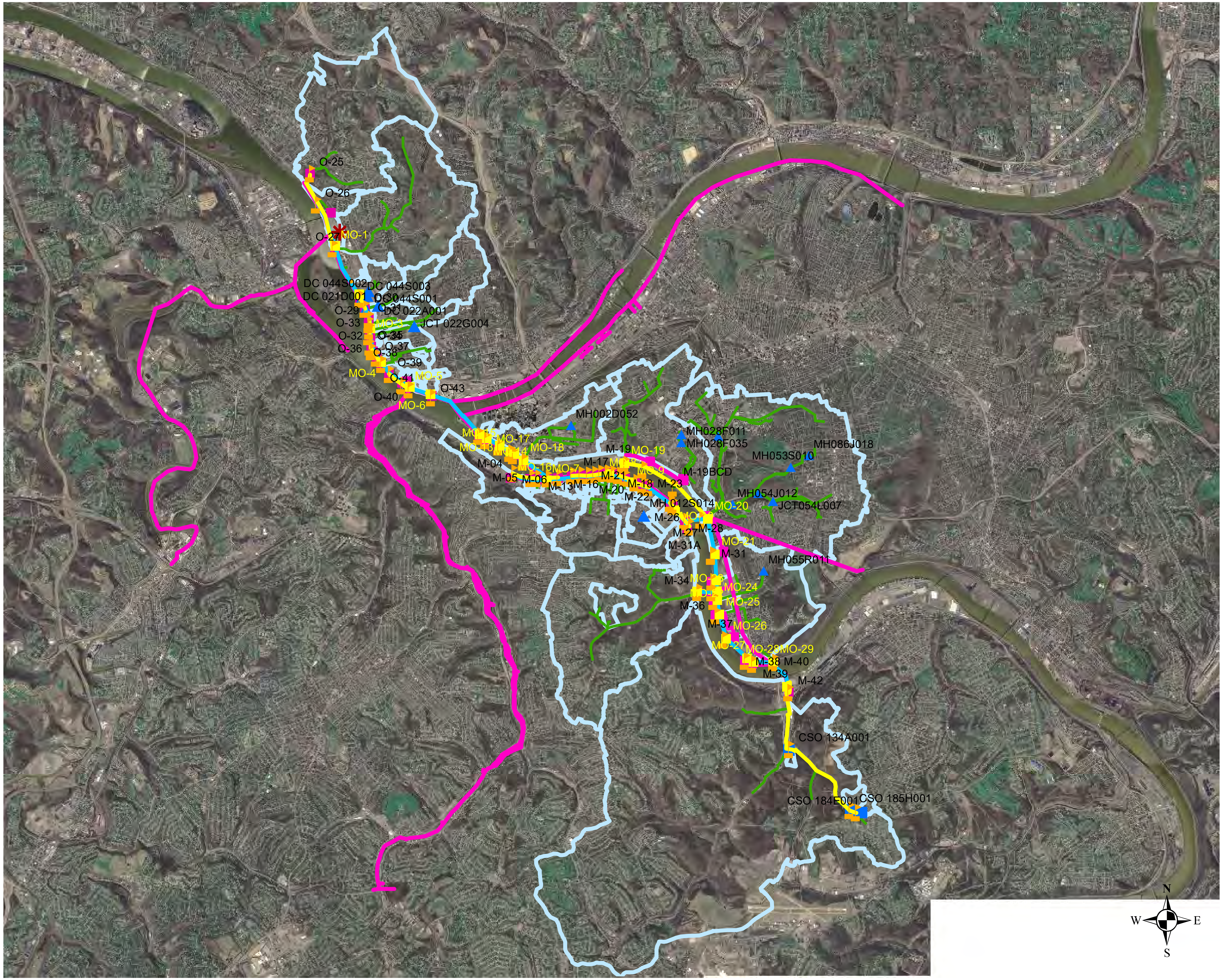

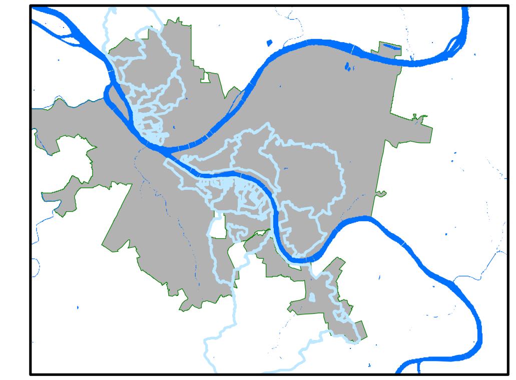

Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel MO-4
- Consolidation Pipe
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

5,000 0 5,000 10,000 Feet

Attachment 7 Subsystem Alternative MO-4 Tunnel Portion

CSO Control Alternatives

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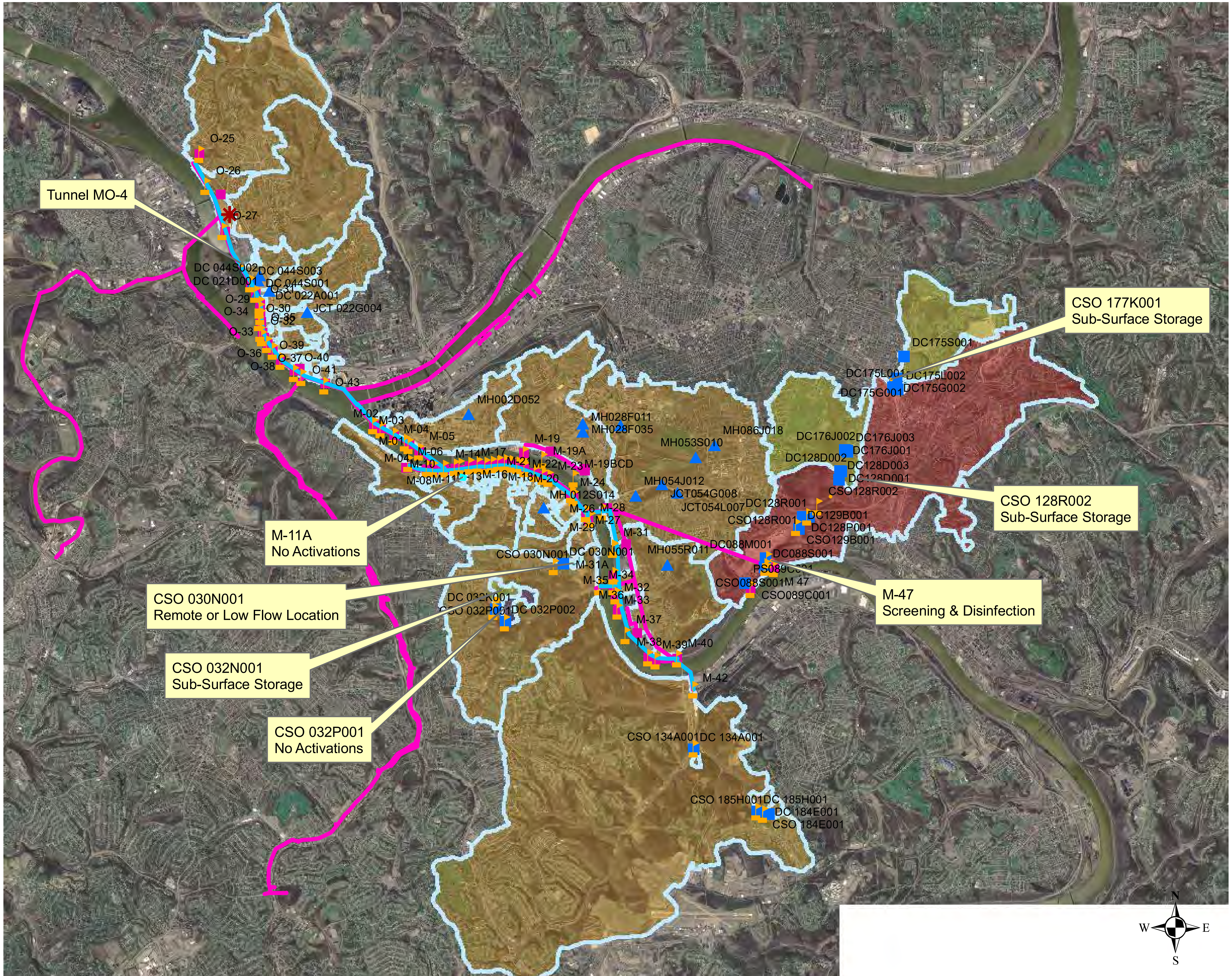
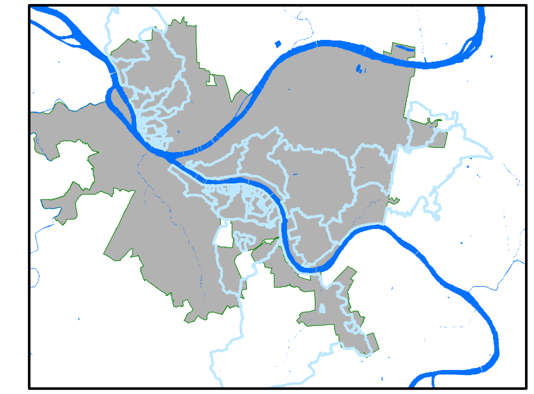




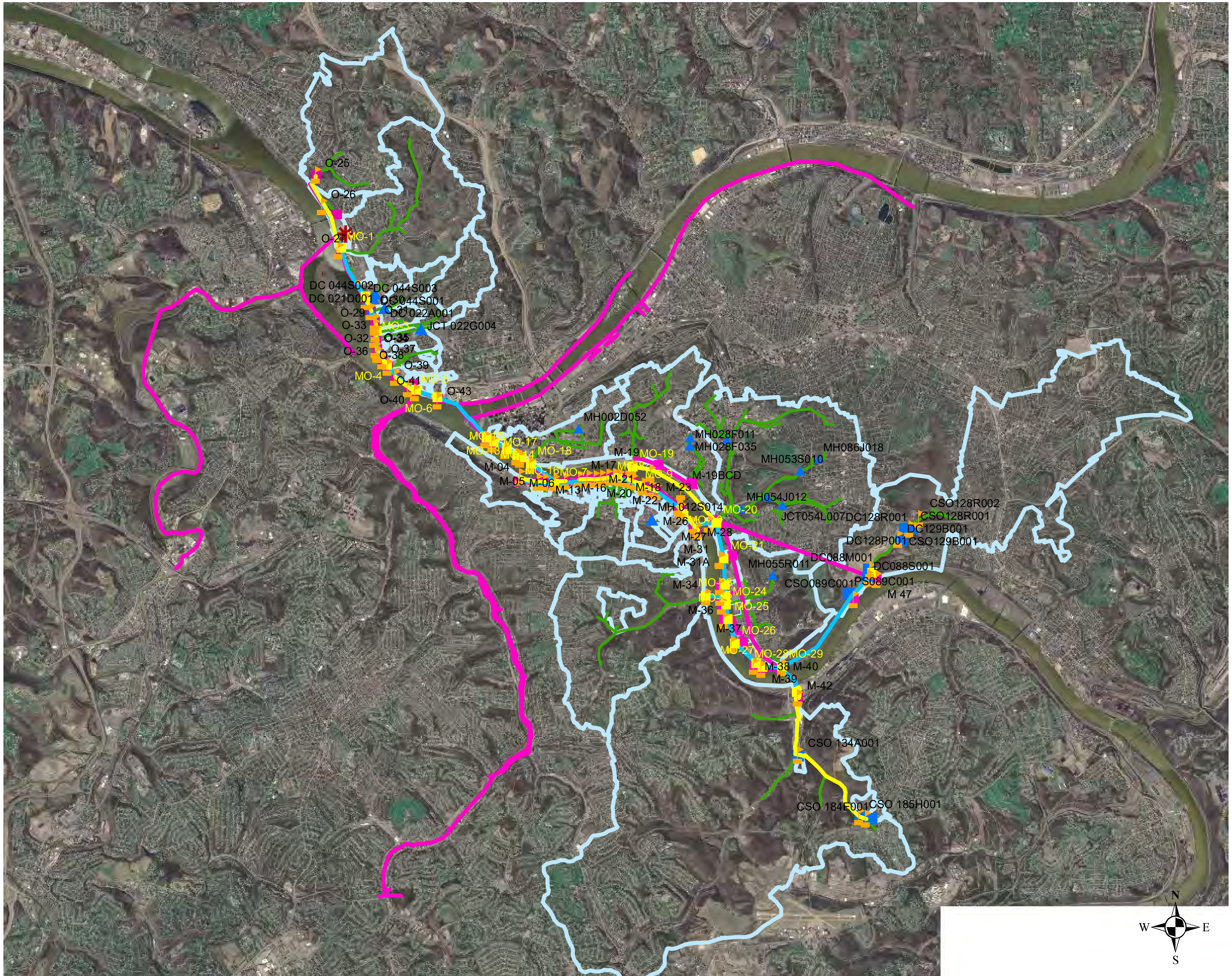
Legend

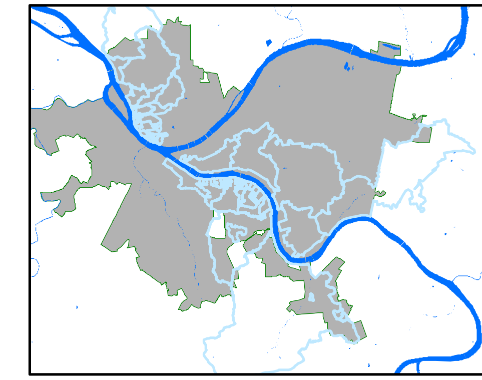
- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Screening & Disinfection
- Sub-Surface Storage
- No Activations
- Remote or Low Flow Location
- Tunnel MO-4
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Combined Sewer Outfall

5,000 0 5,000 10,000 Feet

Attachment 8 Subsystem Alternative MO-4

CSO Control Alternatives





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel MO-5
- Consolidation Pipe
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

5,000 0 5,000 10,000 Feet

Attachment 9
Subsystem Alternative MO-5 Tunnel Portion

CSO Control Alternatives

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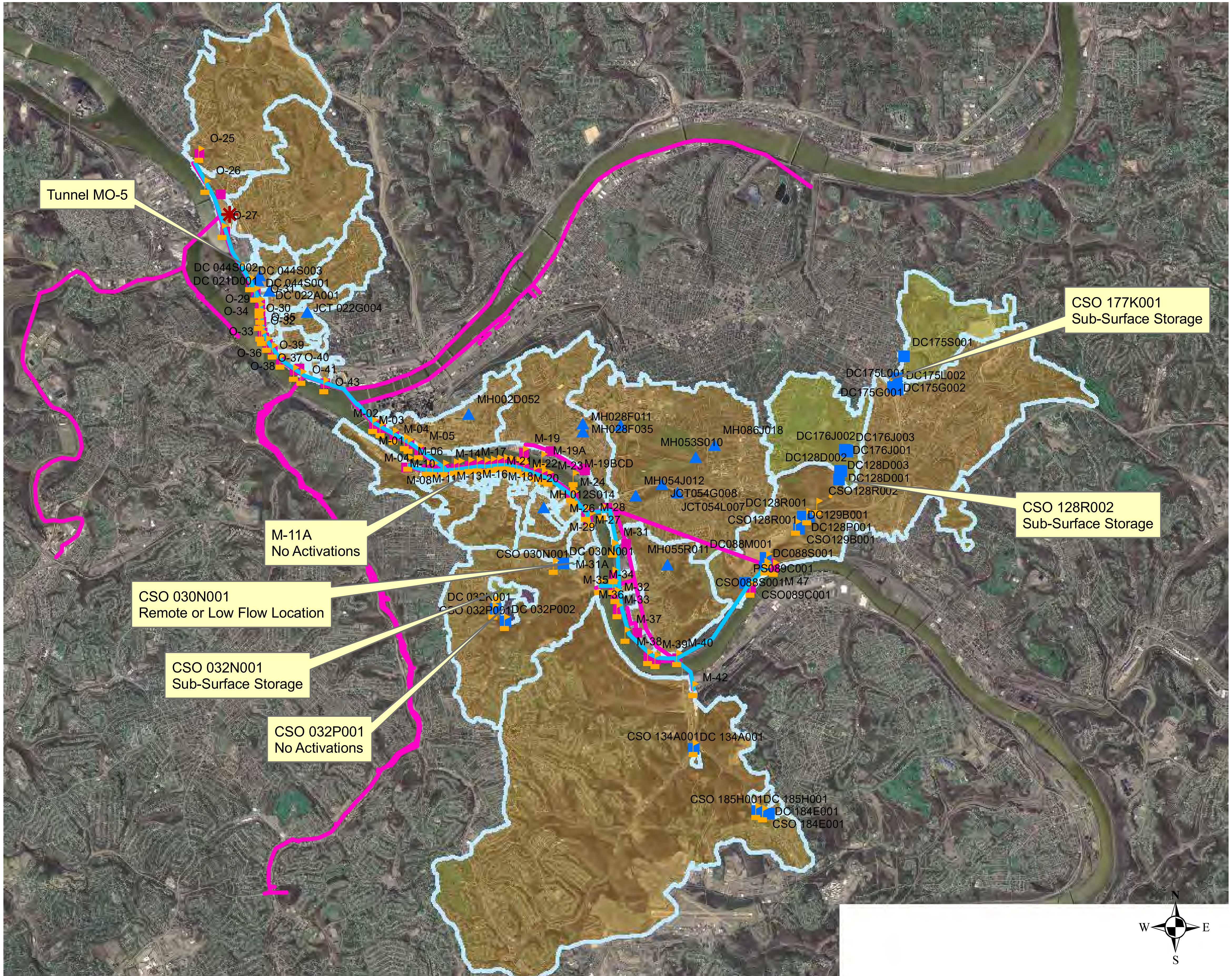

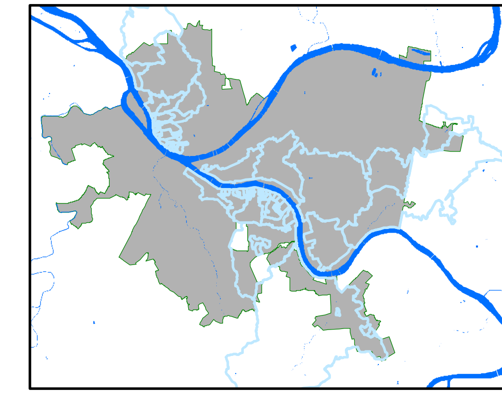

Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Sub-Surface Storage
- No Activations
- Remote or Low Flow Location
- Tunnel MO-5
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Combined Sewer Outfall

5,000 0 5,000 10,000 Feet

Attachment 10 Subsystem Alternative MO-5

CSO Control Alternatives

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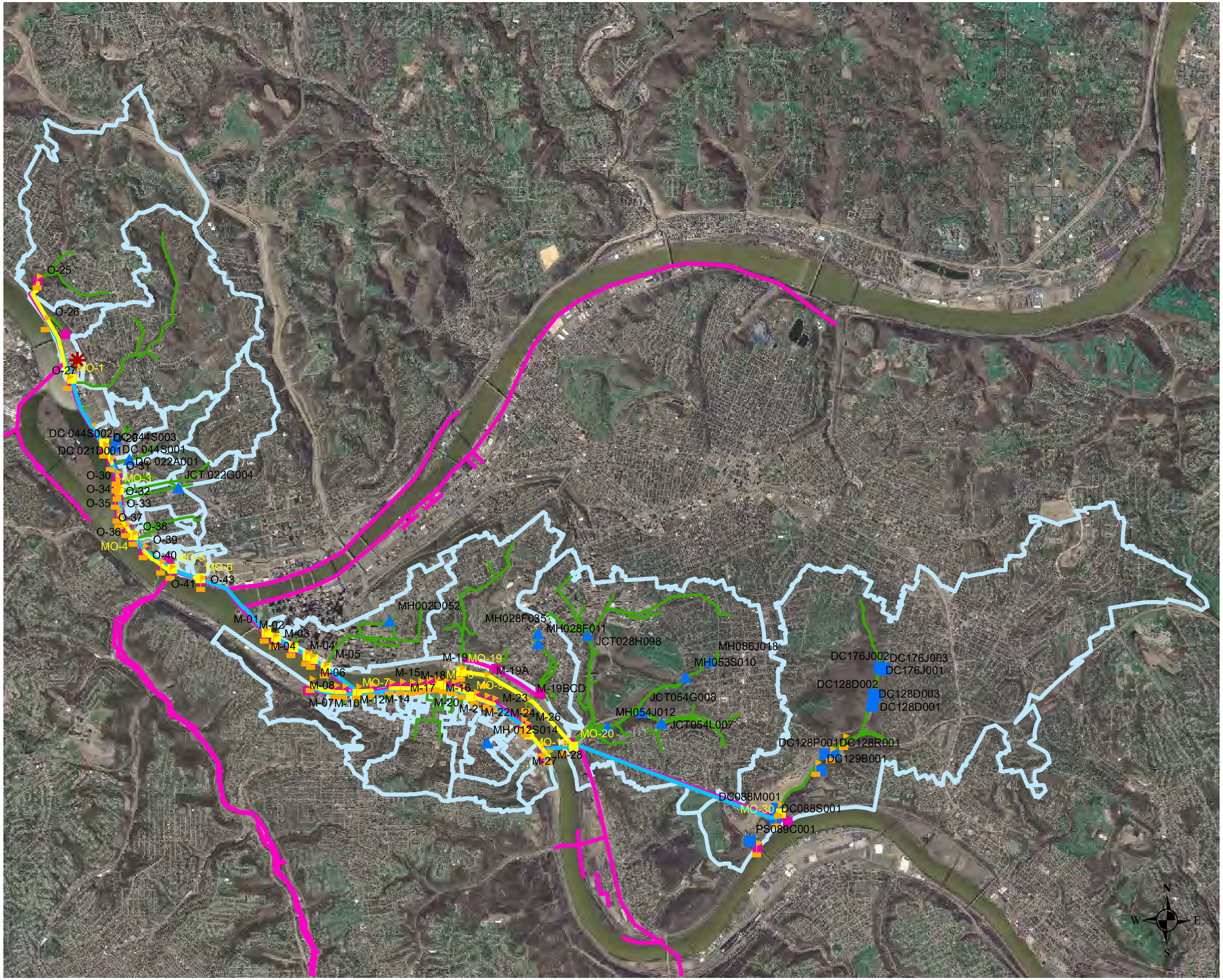

Partnering to achieve long term benefits
PWSA
CSO Team
Metcalf & Eddy Baker/Wade-Trim

Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel MO-6
- Consolidation Pipe
- Trunk Sewer
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Drop Shaft
- Combined Sewer Outfall

5,000 0 5,000 Feet

Attachment 11
Subsystem
Alternative MO-6
Tunnel Portion

CSO Control Alternatives

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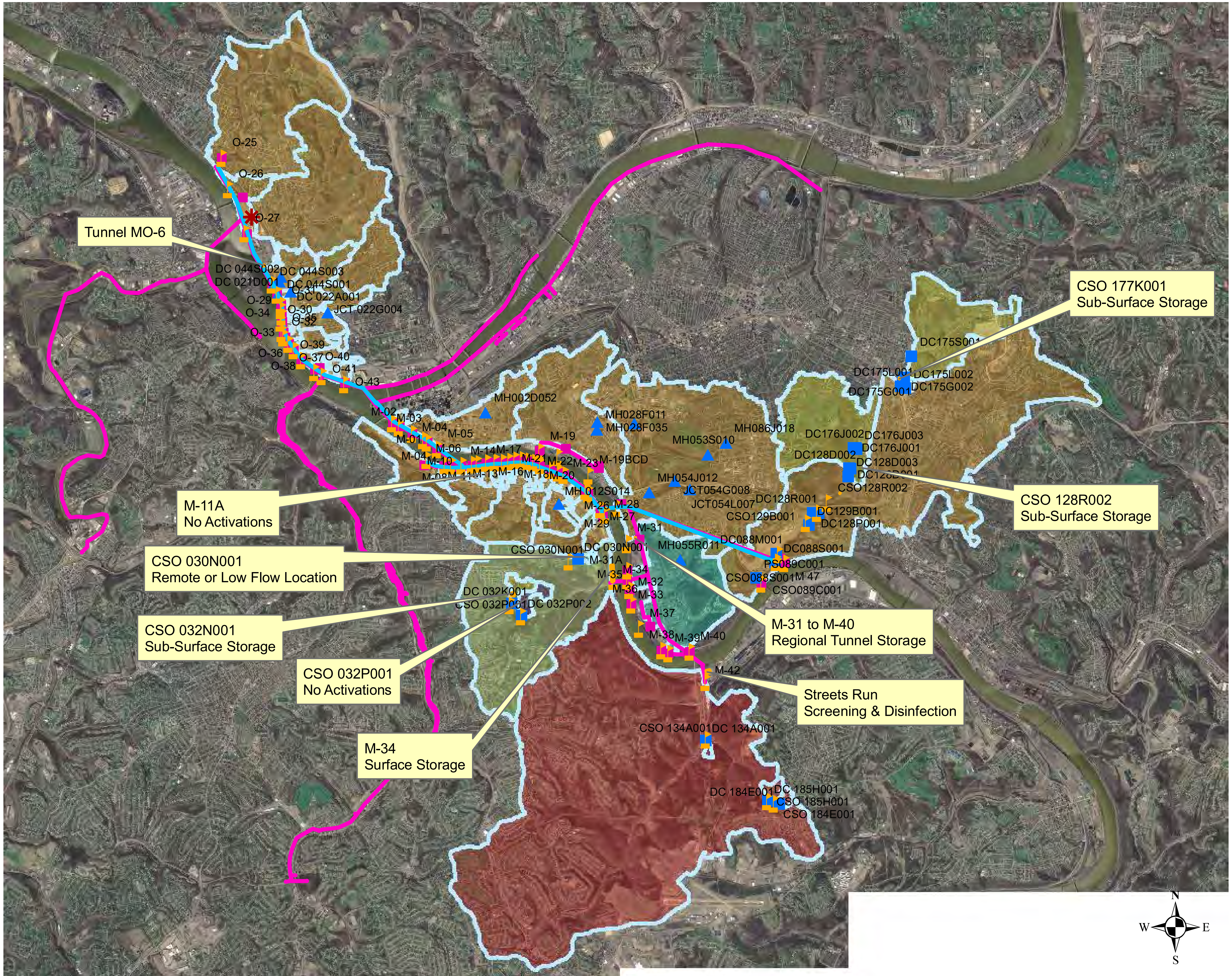
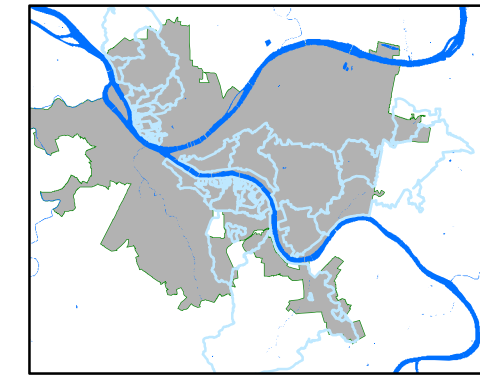
Quality Water Quality Service





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Surface Storage
- Screening & Disinfection
- Sub-Surface Storage
- Regional Tunnel Storage
- No Activations
- Remote or Low Flow Location
- Tunnel MO-6
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- ALCOSAN Treatment Plant
- PWSA Diversion Structure
- PWSA Flow Divider
- Combined Sewer Outfall

5,000 0 5,000 10,000 Feet

Attachment 12 Subsystem Alternative MO-6

CSO Control Alternatives

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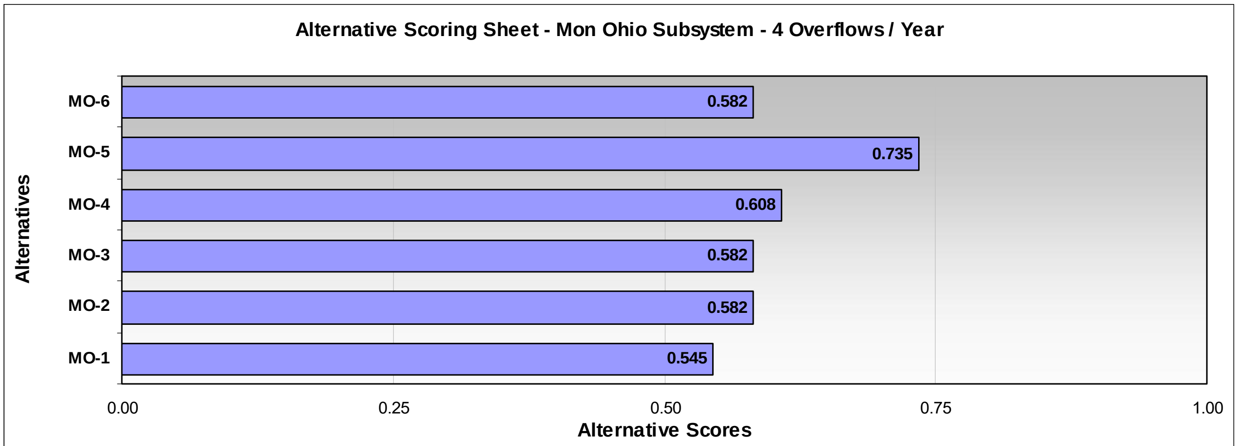
Attachment 13 – Monongahela / Ohio Subsystem Alternative Scoring Sheet



NOTE: All PW Costs are in million $; all capital costs are in $.

SMR-1a				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 37,260,000
TUNNEL STORAGE (O-14 to S-30 w/o LSMR)				
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
CSO 016A001 to 035J001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.42 MG	Sub-Surface Storage	$ 19.4	$ 18,184,559
CSO 036R001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.76 MG	Sub-Surface Storage	$ 10.2	$ 8,889,000
S-23 to S-29 Region				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.38 MG	Sub-Surface Storage	$ 27.7	$ 25,673,012
S-18 to CSO 095J001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.15 MG	Sub-Surface Storage	$ 19.2	$ 18,254,192
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
CSO 097L001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.22 MG	Sub-Surface Storage	$ 4.2	$ 3,385,000
CSO 139A001 to 139B002				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.18 MG	Sub-Surface Storage	$ 21.3	$ 19,590,947
CSO 139B003				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.63 MGD	e/Low Flow (Sewer Sep	$ 3.4	$ 3,358,000
CSO 034R001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.01 MG	e/Low Flow (Sewer Sep	$ 2.6	$ 2,604,000
CSO 138J001 and 138P001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.64 MGD	Sewer Separation	$ 3.2	$ 3,207,000
CSO 138K001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.0	No Activations	$ -	$ -
DC 034N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sep	$1.3	$1,336,000
DC 035P001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sep	$0.7	$655,000
DC 035S001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sep	$0.5	$522,000
DC 062C001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sep	$0.9	$884,000
DC 062D001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sep	$2.4	$2,347,000
DC 062K002				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sep	$0.7	$688,000

SMR-1b				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 66,379,000
TUNNEL STORAGE (O-14 through S-30 w/LSMR))				
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
S-23 to S-29 Region				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.38 MG	Sub-Surface Storage	$ 27.7	$ 25,673,012
S-18 to CSO 095J001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.15 MG	Sub-Surface Storage	$ 19.2	$ 18,254,192
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
CSO 097L001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.22 MG	Sub-Surface Storage	$ 4.2	$ 3,385,000
CSO 139A001 to 139B002				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	1.18 MG	Sub-Surface Storage	$ 21.3	$ 19,590,947
CSO 139B003				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.63 MGD	e/Low Flow (Sewer Sepa	$ 3.4	$ 3,358,000
CSO 034R001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.01 MG	e/Low Flow (Sewer Sepa	$ 2.6	$ 2,604,000
CSO 138J001 and 138P001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.64 MGD	Sewer Separation	$ 3.2	$ 3,207,000
CSO 138K001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.0	No Activations	$ -	$ -
DC 034N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$1.3	$1,336,000
DC 035P001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.7	$655,000
DC 035S001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.5	$522,000
DC 062C001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.9	$884,000
DC 062D001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$2.4	$2,347,000
DC 062K002				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.7	$688,000

SMR-2a				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 72,562,000
TUNNEL STORAGE (O-14 through McDonoughs Run w/o LSMR))				
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
CSO 016A001 to 035J001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.42 MG	Sub-Surface Storage	$ 19.4	$ 18,184,559
CSO 036R001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.76 MG	Sub-Surface Storage	$ 10.2	$ 8,889,000
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
CSO 034R001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.01 MG	e/Low Flow (Sewer Sepa	$ 2.6	$ 2,604,000
CSO 138J001 and 138P001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.64 MGD	Sewer Separation	$ 3.2	$ 3,207,000
CSO 138K001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.0	No Activations	$ -	$ -
DC 034N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$1.3	$1,336,000
DC 035P001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.7	$655,000
DC 035S001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.5	$522,000
DC 062C001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.9	$884,000
DC 062D001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$2.4	$2,347,000
DC 062K002				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.7	$688,000

SMR-2b				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 101,681,000
TUNNEL STORAGE (O-14 through McDonoughs Run w/LSMR))				
RIVER CROSSING #1 - Microtunnel				
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
CSO 034R001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.01 MG	e/Low Flow (Sewer Sepa	$ 2.6	$ 2,604,000
CSO 138J001 and 138P001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.64 MGD	Sewer Separation	$ 3.2	$ 3,207,000
CSO 138K001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	0.0	No Activations	$ -	$ -
DC 034N001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$1.3	$1,336,000
DC 035P001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.7	$655,000
DC 035S001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.5	$522,000
DC 062C001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.9	$884,000
DC 062D001				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$2.4	$2,347,000
DC 062K002				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):		Low Flow/Remote (Sewer Sepa	$0.7	$688,000

Objective Scoring

Alternative:	SMR-1a	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	5
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	SMR-1a	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP	3
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	SMR-1a	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	3
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	SMR-1a	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	2
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	SMR-1a	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	2
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	SMR-1a	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	SMR-1a	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	SMR-1a	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	SMR-1a	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	2
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	SMR-1a	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	SMR-1a	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	5
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	SMR-1a	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	3
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	SMR-1a	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	2
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	SMR-1b	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	5
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	SMR-1b	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP	3
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	SMR-1b	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	3
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	SMR-1b	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	2
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	SMR-1b	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	3
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	SMR-1b	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	SMR-1b	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	3
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	SMR-1b	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	SMR-1b	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	3
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	SMR-1b	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	SMR-1b	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	5
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	SMR-1b	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	3
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	SMR-1b	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	SMR-2a	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	5
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	SMR-2a	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP	3
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	SMR-2a	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	3
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	SMR-2a	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	3
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	SMR-2a	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	3
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	SMR-2a	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	SMR-2a	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	SMR-2a	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	SMR-2a	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	4
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	SMR-2a	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	SMR-2a	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	5
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	SMR-2a	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	3
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	SMR-2a	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	3
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	SMR-2b	Objective Scoring: Present Worth	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	5
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	SMR-2b	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	3
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	SMR-2b	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	3
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	SMR-2b	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	3
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	SMR-2b	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	3
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	SMR-2b	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	3
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	SMR-2b	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	3
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	SMR-2b	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req’s	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	
3	Moderate Req’s	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	3
5	No Req’s	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	SMR-2b	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	4
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	SMR-2b	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	SMR-2b	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	5
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	SMR-2b	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	3
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	**SMR-2b**	**Objective Scoring: Annual O&M**	**Actual Scores**
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	4
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Total Score

Alternative:	SMR-1a		Control Level:	0 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.112	0.056
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.589**

Alternative:	SMR-1a		Control Level:	1 Overflow / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	4	0.75	0.128	0.096
			Sum Total:	**0.635**

Alternative:	SMR-1a		Control Level:	2 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.603**

Alternative:	SMR-1a		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score

Total Score

Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	2	0.25	0.128	0.032
			Sum Total:	**0.571**

Alternative:	**SMR-1a**		**Control Level:**	**6 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	3	0.50	0.147	0.074
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	2	0.15	0.042	0.006
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	2	0.12	0.078	0.009
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.530**

Total Score

Alternative:	SMR-1b		Control Level:	0 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.628**

Alternative:	SMR-1b		Control Level:	1 Overflow / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	3	0.50	0.147	0.074
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	2	0.25	0.128	0.032
			Sum Total:	**0.539**

Alternative:	SMR-1b		Control Level:	2 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.644**

Alternative:	SMR-1b		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score

Total Score

Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.644**

Alternative:	**SMR-1b**		**Control Level:**	**6 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	3	0.50	0.147	0.074
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.571**

Total Score

Alternative:	SMR-2a		Control Level:	0 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.678**

Alternative:	SMR-2a		Control Level:	1 Overflow / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	4	0.75	0.128	0.096
			Sum Total:	**0.727**

Alternative:	SMR-2a		Control Level:	2 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.695**

Alternative:	SMR-2a		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score

Total Score

Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.695**

Alternative:	**SMR-2a**		**Control Level:**	**6 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.695**

Total Score

Alternative:	SMR-2b		Control Level:	0 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.678**

Alternative:	SMR-2b		Control Level:	1 Overflow / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	4	0.75	0.147	0.110
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	2	0.25	0.128	0.032
			Sum Total:	**0.626**

Alternative:	SMR-2b		Control Level:	2 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.695**

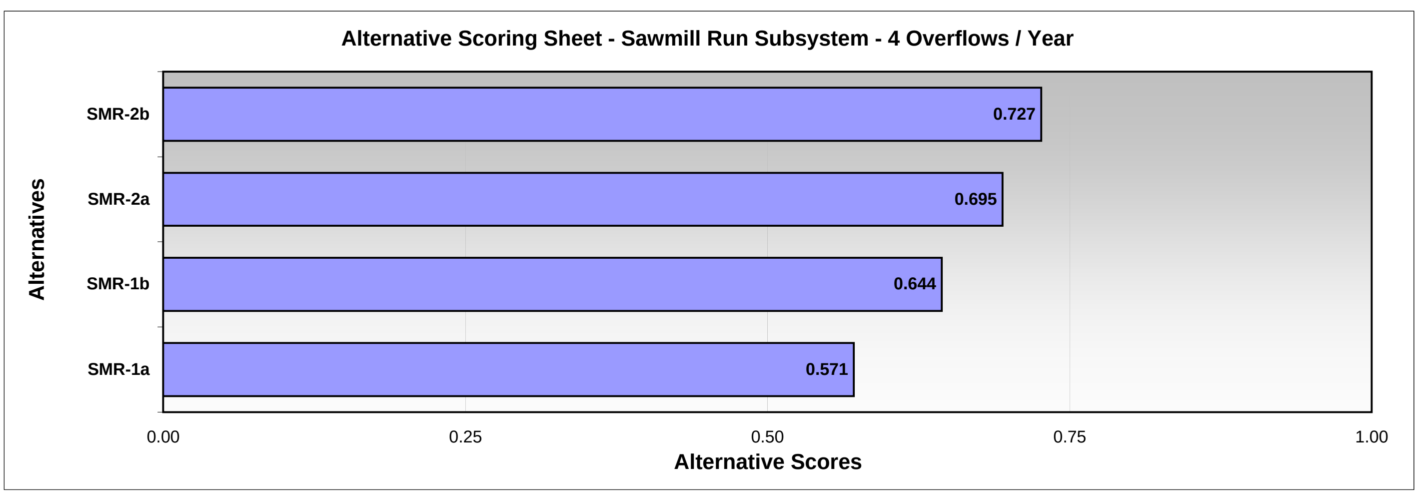
Alternative:	SMR-2b		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score

Total Score

Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	4	0.75	0.128	0.096
			Sum Total:	**0.727**

Alternative:	**SMR-2b**		**Control Level:**	**6 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	3	0.50	0.128	0.064
			Sum Total:	**0.695**

Alternative Scoring Sheet



Capital Costs

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	77	
Peak Volume	2,875,144	CF
	21.51	MG
Total Volume	63,162,851	CF
	472.46	MG
Peak Rate	262.93	CFS
	169.92	MGD

CONSOLIDATION SEWERS - Total		
77 Overflows / Year		
SUBTOTAL CAPITAL COST	**$**	**37,260,000**

Capital Costs

TUNNEL STORAGE (O-14 to S-30 w/o LSMR)				
77 Overflows / Year				
1. Tunnel Parameters				
Tunnel Type (1=Rock; 2=Soft Ground)		1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		21.51	2,875,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)		26.88	3,594,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		17.5		Input by Engineer
Tunnel Volume / Ft length (CF)		240.41		Ref: Tunnel diameter
Tunnel Length (Ft)		14,950		= Req'd Fac Vol / Vol per Ft Length; Target length is 14,624 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		7	9	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MDG)		0	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**63,103,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters				
Volume Requiring Pumping (%)		100%		Ref: Technical Parameters
Dewatering Time (Days)		1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		21.51	33.28	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		32		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		6.0	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		100		Input by Engineer
Construction Cost (PS / Force Main)	**$**	**5,529,000**	**$ 40,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)				
Peak Flow (CFS) per Vortex Drop Shaft		29.21		Peak Flow / # drop shaft
Diameter (In)		48		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-		75' per drop shaft
Average Depth (Ft)		-		Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters				
Air Changes / Hour (ACH)		3		Ref: Technical Parameters
Volume of Ventilated Space (CF)		5,391,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)		269,550		= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**7,353,000**		
5. Screening Parameters				
Screening Required (Yes = 1; No = 2)		1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		21.51		Ref: CSO Statistics
Construction Cost (Screening)	**$**	**1,408,000**		
6. Stored Volume Treatment				
Volume Requiring Treatment (MG)		21.51		Peak Volume (MG)
Dewatering Time (Days)		2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		10.75		= Peak Vol/DW Time
Construction Cost	**$**	**13,229,256**		
7. Regulator Parameters				
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators		9		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**11,565,000**		
8. Land Acquisition Parameters				
Land Required - Drop Shafts (SF)		22,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)		5,377		250 SF / MGD
Land Required - Odor Control (SF)		13,478		500 SF / 10,000 CFM
Land Required - Screening (SF)		5,377		250 SF / MGD
Land Required - Regulator (SF)		90,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*137,000*		
Land Required Cost (/ SF)	$	2		Ref: Technical Parameters
Land Acquisition Cost	**$**	**274,000**		
			SUBTOTAL CAPITAL COST $	**102,501,256**

Capital Costs

RIVER CROSSING #1 - Microtunnel - N/A			
77 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
77 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

Capital Costs

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
77 Overflows / Year			
1. CSO 016A001 to 035J001			
Sub-Surface Storage	0.42 MG	18,184,559	Size & Cost by Engineer (from Regional Alts)
2. CSO 036R001			
Sub-Surface Storage	0.76 MG	8,889,000	Size & Cost by Engineer (from Regional Alts)
3. S-23 to S-29 Region			
Sub-Surface Storage	1.38 MG	25,673,012	Size & Cost by Engineer (from Regional Alts)
4. S-18 to CSO 095J001			
Sub-Surface Storage	0.15 MG	18,254,192	Size & Cost by Engineer (from Regional Alts)
5.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
6. CSO 097L001			
Sub-Surface Storage	0.22 MG	3,385,000	Size & Cost by Engineer (from Regional Alts)
7. CSO 139A001 to 139B002			
Sub-Surface Storage	1.18 MG	19,590,947	Size & Cost by Engineer (from Regional Alts)
8. CSO 139B003			
Remote/Low Flow (Sewer Separation)	0.63 MGD	3,358,000	Size & Cost by Engineer (from Regional Alts)
9. CSO 034R001			
Remote/Low Flow (Sewer Separation)	0.01 MG	2,604,000	Size & Cost by Engineer (from Regional Alts)
10. CSO 138J001 and 138P001			
Sewer Separation	0.64 MGD	3,207,000	Size & Cost by Engineer (from Regional Alts)
11. CSO 138K001			
No Activations	-	-	Size & Cost by Engineer (from Regional Alts)
DC 034N001			
Low Flow/Remote (Sewer Separation)		1,336,000	Size & Cost by Engineer (from Regional Alts)
DC 035P001			
Low Flow/Remote (Sewer Separation)		655,000	Size & Cost by Engineer (from Regional Alts)
DC 035S001			
Low Flow/Remote (Sewer Separation)		522,000	Size & Cost by Engineer (from Regional Alts)
DC 062C001			
Low Flow/Remote (Sewer Separation)		884,000	Size & Cost by Engineer (from Regional Alts)
DC 062D001			
Low Flow/Remote (Sewer Separation)		2,347,000	Size & Cost by Engineer (from Regional Alts)
DC 062K002			
Low Flow/Remote (Sewer Separation)		688,000	Size & Cost by Engineer (from Regional Alts)
		SUBTOTAL CAPITAL COST	**$ 109,577,710**

TOTAL CAPITAL COST $ 249,338,966

Capital Costs

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	82	
Peak Volume	2,977,483	CF
	22.27	MG
Total Volume	66,330,995	CF
	496.16	MG
Peak Rate	316.19	CFS
	204.35	MGD

CONSOLIDATION SEWERS - Total		
82 Overflows / Year		
SUBTOTAL CAPITAL COST	**$**	**66,379,000**

Capital Costs

TUNNEL STORAGE (O-14 through S-30 w/LSMR))					
82 Overflows / Year					
1. Tunnel Parameters					
Tunnel Type (1=Rock; 2=Soft Ground)		1		**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		22.27		2,977,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%			Ref: Technical Parameters
Required Facility Volume (MG / CF)		27.84		3,721,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		18			Input by Engineer
Tunnel Volume / Ft length (CF)		254.34			Ref: Tunnel diameter
Tunnel Length (Ft)		14,630			= Req'd Fac Vol / Vol per Ft Length; Target length is 14,624 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000			Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		7		9	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MDG)					Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**64,390,000**			OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters					
Volume Requiring Pumping (%)		100%			Ref: Technical Parameters
Dewatering Time (Days)		1			Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		22.27		34.46	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		32			DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		6.2		**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		100			Input by Engineer
Construction Cost (PS / Force Main)	**$**	**5,727,000**	**$**	**40,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)					
Peak Flow (CFS) per Vortex Drop Shaft		35.13			Peak Flow / # drop shaft
Diameter (In)		48			<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-			75' per drop shaft
Average Depth (Ft)		-			Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**			Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters					
Air Changes / Hour (ACH)		3			Ref: Technical Parameters
Volume of Ventilated Space (CF)		5,582,000			= 1.5 x Volume
Odor Control Flow Rate (CFM)		279,100			= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**7,557,000**			
5. Screening Parameters					
Screening Required (Yes = 1; No = 2)		1			Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		22.27			Ref: CSO Statistics
Construction Cost (Screening)	**$**	**1,443,000**			
6. Stored Volume Treatment					
Volume Requiring Treatment (MG)		22.27			Peak Volume (MG)
Dewatering Time (Days)		2			Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		11.14			= Peak Vol/DW Time
Construction Cost	**$**	**13,415,751**			
7. Regulator Parameters					
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2		**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators		9			Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**11,565,000**			
8. Land Acquisition Parameters					
Land Required - Drop Shafts (SF)		22,500			2,500 SF / Shaft
Land Required - Dewatering PS (SF)		5,568			250 SF / MGD
Land Required - Odor Control (SF)		13,955			500 SF / 10,000 CFM
Land Required - Screening (SF)		5,568			250 SF / MGD
Land Required - Regulator (SF)		90,000			Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*138,000*			
Land Required Cost (/ SF)	$	2			Ref: Technical Parameters
Land Acquisition Cost	**$**	**276,000**			
				SUBTOTAL CAPITAL COST	**$ 104,413,751**

Capital Costs

RIVER CROSSING #1 - Microtunnel - N/A					
82 Overflows / Year					
Peak Flow (CFS) - N/A		-		-	Ref: Technical Parameters
Diameter (In)		36		36	Ref: Technical Parameters
Length - Open Cut (Ft)		-		-	Input by Engineer
Depth - Open Cut (Ft)		-		-	Input by Engineer
Length - Microtunnel (Ft)		-		-	Input by Engineer
No. of Interceptor Connections Req'd		-		-	Input by Engineer
Construction Cost (Interceptor Connections)	**$**	**-**	**$**	**-**	Ref: Cost Curves
Construction Cost (Open Cut)	**$**	**-**	**$**	**-**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$**	**-**	**$**	**-**	Ref: Cost Curves
				SUBTOTAL CAPITAL COST	**$ -**

RIVER CROSSING #2 - Microtunnel - N/A					
82 Overflows / Year					
Peak Flow (CFS) - N/A		-		-	Ref: Technical Parameters
Diameter (In)		36		36	Ref: Technical Parameters
Length - Open Cut (Ft)		-		-	Input by Engineer
Depth - Open Cut (Ft)		-		-	Input by Engineer
Length - Microtunnel (Ft)		-		-	Input by Engineer
No. of Interceptor Connections Req'd		-		-	Input by Engineer
Construction Cost (Interceptor Connections)	**$**	**-**	**$**	**-**	Ref: Cost Curves
Construction Cost (Open Cut)	**$**	**-**	**$**	**-**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$**	**-**	**$**	**-**	Ref: Cost Curves
				SUBTOTAL CAPITAL COST	**$ -**

Capital Costs

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
82 Overflows / Year			
1.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
2.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
3. S-23 to S-29 Region			
Sub-Surface Storage	1.38 MG	25,673,012	Size & Cost by Engineer (from Regional Alts)
4. S-18 to CSO 095J001			
Sub-Surface Storage	0.15 MG	18,254,192	Size & Cost by Engineer (from Regional Alts)
5.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
6. CSO 097L001			
Sub-Surface Storage	0.22 MG	3,385,000	Size & Cost by Engineer (from Regional Alts)
7. CSO 139A001 to 139B002			
Sub-Surface Storage	1.18 MG	19,590,947	Size & Cost by Engineer (from Regional Alts)
8. CSO 139B003			
Remote/Low Flow (Sewer Separation)	0.63 MGD	3,358,000	Size & Cost by Engineer (from Regional Alts)
9. CSO 034R001			
Remote/Low Flow (Sewer Separation)	0.01 MG	2,604,000	Size & Cost by Engineer (from Regional Alts)
10. CSO 138J001 and 138P001			
Sewer Separation	0.64 MGD	3,207,000	Size & Cost by Engineer (from Regional Alts)
11. CSO 138K001			
No Activations	-	-	Size & Cost by Engineer (from Regional Alts)
DC 034N001			
Low Flow/Remote (Sewer Separation)		1,336,000	Size & Cost by Engineer (from Regional Alts)
DC 035P001			
Low Flow/Remote (Sewer Separation)		655,000	Size & Cost by Engineer (from Regional Alts)
DC 035S001			
Low Flow/Remote (Sewer Separation)		522,000	Size & Cost by Engineer (from Regional Alts)
DC 062C001			
Low Flow/Remote (Sewer Separation)		884,000	Size & Cost by Engineer (from Regional Alts)
DC 062D001			
Low Flow/Remote (Sewer Separation)		2,347,000	Size & Cost by Engineer (from Regional Alts)
DC 062K002			
Low Flow/Remote (Sewer Separation)		688,000	Size & Cost by Engineer (from Regional Alts)
		SUBTOTAL CAPITAL COST	**$ 82,504,151**

TOTAL CAPITAL COST $ 253,296,902

Capital Costs

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	95	
Peak Volume	3,249,482	CF
	24.31	MG
Total Volume	71,752,452	CF
	536.71	MG
Peak Rate	304.44	CFS
	196.75	MGD

CONSOLIDATION SEWERS - Total	
95 Overflows / Year	
SUBTOTAL CAPITAL COST $	**72,562,000**

Capital Costs

TUNNEL STORAGE (O-14 through McDonoughs Run w/o LSMR))				
95 Overflows / Year				
1. Tunnel Parameters				
Tunnel Type (1=Rock; 2=Soft Ground)		1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		24.31	3,249,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)		30.38	4,061,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		13		Input by Engineer
Tunnel Volume / Ft length (CF)		132.67		Ref: Tunnel diameter
Tunnel Length (Ft)		30,611		= Req'd Fac Vol / Vol per Ft Length; Target length is 29,617 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		15	12	
Additional Drop Shafts Required (<25 MGD/>25 MDG)				Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**88,698,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters				
Volume Requiring Pumping (%)		100%		Ref: Technical Parameters
Dewatering Time (Days)		1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		24.31	37.61	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		34		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		6.0	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		100		Input by Engineer
Construction Cost (PS / Force Main)	**$**	**6,252,000**	**$ 42,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)				
Peak Flow (CFS) per Vortex Drop Shaft		25.37		Peak Flow / # drop shaft
Diameter (In)		48		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-		75' per drop shaft
Average Depth (Ft)		-		Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters				
Air Changes / Hour (ACH)		3		Ref: Technical Parameters
Volume of Ventilated Space (CF)		6,092,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)		304,600		= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**8,092,000**		
5. Screening Parameters				
Screening Required (Yes = 1; No = 2)		1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		24.31		Ref: CSO Statistics
Construction Cost (Screening)	**$**	**1,538,000**		
6. Stored Volume Treatment				
Volume Requiring Treatment (MG)		24.31		Peak Volume (MG)
Dewatering Time (Days)		2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		12.15		= Peak Vol/DW Time
Construction Cost	**$**	**13,911,544**		
7. Regulator Parameters				
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators		12		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**15,420,000**		
8. Land Acquisition Parameters				
Land Required - Drop Shafts (SF)		30,000		2,500 SF / Shaft
Land Required - Dewatering PS (SF)		6,077		250 SF / MGD
Land Required - Odor Control (SF)		15,230		500 SF / 10,000 CFM
Land Required - Screening (SF)		6,077		250 SF / MGD
Land Required - Regulator (SF)		120,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*177,000*		
Land Required Cost (/ SF)	$	2		Ref: Technical Parameters
Land Acquisition Cost	**$**	**354,000**		
			SUBTOTAL CAPITAL COST $	**134,307,544**

Capital Costs

RIVER CROSSING #1 - Microtunnel - N/A			
95 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
95 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

Capital Costs

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
95 Overflows / Year			
1. CSO 016A001 to 035J001			
Sub-Surface Storage	0.42 MG	18,184,559	Size & Cost by Engineer (from Regional Alts)
2. CSO 036R001			
Sub-Surface Storage	0.76 MG	8,889,000	Size & Cost by Engineer (from Regional Alts)
3.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
4.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
5.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
6.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
7.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
8.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
9. CSO 034R001			
Remote/Low Flow (Sewer Separation)	0.01 MG	2,604,000	Size & Cost by Engineer (from Regional Alts)
10. CSO 138J001 and 138P001			
Sewer Separation	0.64 MGD	3,207,000	Size & Cost by Engineer (from Regional Alts)
11. CSO 138K001			
No Activations	-	-	Size & Cost by Engineer (from Regional Alts)
DC 034N001			
Low Flow/Remote (Sewer Separation)		1,336,000	Size & Cost by Engineer (from Regional Alts)
DC 035P001			
Low Flow/Remote (Sewer Separation)		655,000	Size & Cost by Engineer (from Regional Alts)
DC 035S001			
Low Flow/Remote (Sewer Separation)		522,000	Size & Cost by Engineer (from Regional Alts)
DC 062C001			
Low Flow/Remote (Sewer Separation)		884,000	Size & Cost by Engineer (from Regional Alts)
DC 062D001			
Low Flow/Remote (Sewer Separation)		2,347,000	Size & Cost by Engineer (from Regional Alts)
DC 062K002			
Low Flow/Remote (Sewer Separation)		688,000	Size & Cost by Engineer (from Regional Alts)
		SUBTOTAL CAPITAL COST	**$ 39,316,559**

TOTAL CAPITAL COST $ 246,186,103

Capital Costs

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	97	
Peak Volume	3,450,205	CF
	25.81	MG
Total Volume	74,930,449	CF
	560.48	MG
Peak Rate	358.73	CFS
	231.84	MGD

CONSOLIDATION SEWERS - Total		
97 Overflows / Year		
SUBTOTAL CAPITAL COST	**$**	**101,681,000**

#

Capital Costs

TUNNEL STORAGE (O-14 through McDonoughs Run w/LSMR))				
97 Overflows / Year				
1. Tunnel Parameters				
Tunnel Type (1=Rock; 2=Soft Ground)		1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)		25.81	3,450,000	Ref: CSO Statistics
Available Capacity (% Vol)		80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)		32.26	4,313,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range		13.5		Input by Engineer
Tunnel Volume / Ft length (CF)		143.07		Ref: Tunnel diameter
Tunnel Length (Ft)		30,147		= Req'd Fac Vol / Vol per Ft Length; Target length is 29,617 ft
Drop Shaft Spacing - Default Value = 2,000 ft		2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.		15	12	Actual number of drop shafts if < tunnel cost
Additional Drop Shafts Required (<25 MGD/>25 MDG)				Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel)	**$**	**91,082,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters				
Volume Requiring Pumping (%)		100%		Ref: Technical Parameters
Dewatering Time (Days)		1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)		25.81	39.93	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)		35		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)		6.0	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)		100		Input by Engineer
Construction Cost (PS / Force Main)	**$**	**6,640,000**	**$ 43,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)				
Peak Flow (CFS) per Vortex Drop Shaft		29.89		Peak Flow / # drop shaft
Diameter (In)		48		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)		-		75' per drop shaft
Average Depth (Ft)		-		Input by Engineer
Construction Cost (Consolidation Pipe)	**$**	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters				
Air Changes / Hour (ACH)		3		Ref: Technical Parameters
Volume of Ventilated Space (CF)		6,470,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)		323,500		= ACH x Volume / 60
Construction Cost (Odor Control)	**$**	**8,483,000**		
5. Screening Parameters				
Screening Required (Yes = 1; No = 2)		1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)		25.81		Ref: CSO Statistics
Construction Cost (Screening)	**$**	**1,607,000**		
6. Stored Volume Treatment				
Volume Requiring Treatment (MG)		25.81		Peak Volume (MG)
Dewatering Time (Days)		2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)		12.90		= Peak Vol/DW Time
Construction Cost	**$**	**14,277,530**		
7. Regulator Parameters				
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)		2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators		12		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex)	**$**	**15,420,000**		
8. Land Acquisition Parameters				
Land Required - Drop Shafts (SF)		30,000		2,500 SF / Shaft
Land Required - Dewatering PS (SF)		6,452		250 SF / MGD
Land Required - Odor Control (SF)		16,175		500 SF / 10,000 CFM
Land Required - Screening (SF)		6,452		250 SF / MGD
Land Required - Regulator (SF)		120,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)		*179,000*		
Land Required Cost (/ SF)	$	2		Ref: Technical Parameters
Land Acquisition Cost	**$**	**358,000**		
			SUBTOTAL CAPITAL COST $	**137,910,530**

Capital Costs

RIVER CROSSING #1 - Microtunnel - N/A			
97 Overflows / Year			
Peak Flow (CFS) - N/A	Input Flow	Input Flow	Ref: Technical Parameters
Diameter (In)	120	120	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
97 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

Capital Costs

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
97 Overflows / Year			
1.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
2.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
3.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
4.			
0			Size & Cost by Engineer (from Regional Alts)
5.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
6.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
7.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
8.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
9. CSO 034R001			
Remote/Low Flow (Sewer Separation)	0.01 MG	2,604,000	Size & Cost by Engineer (from Regional Alts)
10. CSO 138J001 and 138P001			
Sewer Separation	0.64 MGD	3,207,000	Size & Cost by Engineer (from Regional Alts)
11. CSO 138K001			
No Activations	-	-	Size & Cost by Engineer (from Regional Alts)
DC 034N001			
Low Flow/Remote (Sewer Separation)		1,336,000	Size & Cost by Engineer (from Regional Alts)
DC 035P001			
Low Flow/Remote (Sewer Separation)		655,000	Size & Cost by Engineer (from Regional Alts)
DC 035S001			
Low Flow/Remote (Sewer Separation)		522,000	Size & Cost by Engineer (from Regional Alts)
DC 062C001			
Low Flow/Remote (Sewer Separation)		884,000	Size & Cost by Engineer (from Regional Alts)
DC 062D001			
Low Flow/Remote (Sewer Separation)		2,347,000	Size & Cost by Engineer (from Regional Alts)
DC 062K002			
Low Flow/Remote (Sewer Separation)		688,000	Size & Cost by Engineer (from Regional Alts)
		SUBTOTAL CAPITAL COST	**$ 12,243,000**

TOTAL CAPITAL COST $ 251,834,530

Operation and Maintenance Costs

Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
TUNNEL STORAGE (O-14 to S-30 w/o LSMR)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	21.51	$146,007	20	10.910	$1,592,924
	Tunnel Maintenance	Length (ft)	14950	$4,784	50	14.484	$69,288
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	9	$177,149	50	14.484	$2,565,747
	Screening O&M	Flow Rate (MGD)	21.51	$9,303	20	10.910	$101,492
	Odor Control O&M	Capacity (CFM)	269,550	$943,425	20	10.910	$10,292,709
	Reserve / Replace	10% Gravity / 15% Pump					$46,388
			Subtotal Annual O&M	**$1,281,000**		**Subtotal PW O&M**	**$14,669,000**

Subsystem Components	
CSO 016A001 to 035J001	$91,000
CSO 036R001	$100,000
S-23 to S-29 Region	$325,000
S-18 to CSO 095J001	$68,000
CSO 097L001	$61,000
CSO 139A001 to 139B002	$135,000
CSO 139B003	$0
CSO 034R001	$0
CSO 138J001 and 138P001	$0
CSO 138K001	$0
DC 034N001	$0
DC 035P001	$0
DC 035P001	$0
DC 035S001	$0
DC 062C001	$0
DC 062D001	$0
DC 062K002	$0

TOTAL ANNUAL O&M	**$2,061,000**
ANNUAL O&M ($MM)	**$2.06**

Operation and Maintenance Costs

Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
TUNNEL STORAGE (O-14 through S-30 w/LSMR))							
0	Requirement	Input Parameter	Input Value	Annual O&M Cost	Service Life (Yr)	Present Worth Factor	Present Worth
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	22.27	$149,459	20	10.910	$1,630,584
	Tunnel Maintenance	Length (ft)	14630	$4,682	50	14.484	$67,806
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	9	$177,149	50	14.484	$2,565,747
	Screening O&M	Flow Rate (MGD)	22.27	$9,372	20	10.910	$102,251
	Odor Control O&M	Capacity (CFM)	279,100	$976,850	20	10.910	$10,657,374
	Reserve / Replace	10% Gravity / 15% Pump					$47,846
			Subtotal Annual O&M	$1,318,000		Subtotal PW O&M	$15,072,000

Subsystem Components	
CSO 016A001 to 035J001	--
CSO 036R001	--
S-23 to S-29 Region	$325,000
S-18 to CSO 095J001	$68,000
CSO 097L001	$61,000
CSO 139A001 to 139B002	$135,000
CSO 139B003	$0
CSO 034R001	$0
CSO 138J001 and 138P001	$0
CSO 138K001	$0
DC 034N001	$0
DC 035P001	$0
DC 035P001	$0
DC 035S001	$0
DC 062C001	$0
DC 062D001	$0
DC 062K002	$0

TOTAL ANNUAL O&M	**$1,907,000**
ANNUAL O&M ($MM)	**$1.91**

Operation and Maintenance Costs

Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
TUNNEL STORAGE (O-14 through McDonoughs Run w/o LSMR))							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	24.31	$158,447	20	10.910	$1,728,652
	Tunnel Maintenance	Length (ft)	30611	$9,795	50	14.484	$141,874
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	12	$186,198	50	14.484	$2,696,816
	Screening O&M	Flow Rate (MGD)	24.31	$9,558	20	10.910	$104,279
	Odor Control O&M	Capacity (CFM)	304,600	$1,066,100	20	10.910	$11,631,086
	Reserve / Replace	10% Gravity / 15% Pump					$51,702
			Subtotal Annual O&M	**$1,431,000**		**Subtotal PW O&M**	**$16,355,000**

Subsystem Components	
CSO 016A001 to 035J001	$91,000
CSO 036R001	$100,000
S-23 to S-29 Region	--
S-18 to CSO 095J001	--
CSO 097L001	--
CSO 139A001 to 139B002	--
CSO 139B003	--
CSO 034R001	$0
CSO 138J001 and 138P001	$0
CSO 138K001	$0
DC 034N001	$0
DC 035P001	$0
DC 035P001	$0
DC 035S001	$0
DC 062C001	$0
DC 062D001	$0
DC 062K002	$0
TOTAL ANNUAL O&M	**$1,622,000**
ANNUAL O&M ($MM)	**$1.62**

Operation and Maintenance Costs

Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
TUNNEL STORAGE (O-14 through McDonoughs Run w/LSMR))							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	25.81	$164,921	20	10.910	$1,799,280
	Tunnel Maintenance	Length (ft)	30147	$9,647	50	14.484	$139,723
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	12	$186,198	50	14.484	$2,696,816
	Screening O&M	Flow Rate (MGD)	25.81	$9,696	20	10.910	$105,787
	Odor Control O&M	Capacity (CFM)	323,500	$1,132,250	20	10.910	$12,352,779
	Reserve / Replace	10% Gravity / 15% Pump					$54,536
			Subtotal Annual O&M	**$1,503,000**		**Subtotal PW O&M**	**$17,149,000**

Subsystem Components	
CSO 016A001 to 035J001	--
CSO 036R001	--
S-23 to S-29 Region	--
S-18 to CSO 095J001	--
CSO 097L001	--
CSO 139A001 to 139B002	--
CSO 139B003	--
CSO 034R001	$0
CSO 138J001 and 138P001	$0
CSO 138K001	$0
DC 034N001	$0
DC 035P001	$0
DC 035P001	$0
DC 035S001	$0
DC 062C001	$0
DC 062D001	$0
DC 062K002	$0
TOTAL ANNUAL O&M	**$1,503,000**
ANNUAL O&M ($MM)	**$1.50**

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	SMR-1a
Structures within Region	#N/A
Model ID	SMR-1a.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	77
Peak Volume:	20,433,097 ft^3
	152.85 MG
Total Volume:	63,162,851 ft^3
	472.49 MG
Peak Rate:	751.49 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/3/2005 8:10	7395	1/5/2005 14:45	20433097.13	152849.783	0	163.22	9
1/11/2005 7:55	2251	1/12/2005 1:30	5040205.31	37703.256	1	143.15	12
2/14/2005 4:53	1935	2/14/2005 10:00	3858137.35	28860.796	2	91.71	26
3/28/2005 8:52	1540	3/28/2005 19:15	3342779.67	25005.663	3	123.10	19
11/29/2005 1:45	1550	11/29/2005 11:15	2875143.89	21507.514	4	141.83	13
5/13/2005 22:25	2254	5/13/2005 22:45	2745566.26	20538.208	5	273.12	3
10/24/2005 11:42	2203	10/25/2005 3:00	2448542.06	18316.319	6	60.12	32
4/1/2005 19:17	2362	4/2/2005 7:00	2152231.86	16099.770	7	110.27	21
8/20/2005 18:15	225	8/20/2005 19:00	2126007.25	15903.597	8	751.49	0
1/13/2005 22:30	1052	1/14/2005 2:15	1784639.60	13349.997	9	127.23	18
11/14/2005 21:40	624	11/15/2005 3:45	1585632.83	11861.326	10	165.69	8
12/15/2005 9:56	1019	12/15/2005 14:00	1172311.40	8769.475	11	95.35	25
7/5/2005 16:15	195	7/5/2005 17:00	1158815.21	8668.517	12	262.93	4
2/20/2005 15:30	1194	2/20/2005 20:30	913815.03	6835.793	13	127.30	17
10/21/2005 18:41	1445	10/22/2005 7:00	864209.77	6464.721	14	73.15	28
4/22/2005 15:50	1219	4/23/2005 4:30	863775.85	6461.475	15	128.85	16
7/26/2005 19:35	489	7/26/2005 20:00	852038.03	6373.670	16	325.39	1
7/15/2005 17:30	160	7/15/2005 18:15	791393.67	5920.020	17	296.47	2
3/23/2005 2:25	794	3/23/2005 12:45	710432.52	5314.390	18	60.27	31
8/29/2005 9:05	444	8/29/2005 13:45	709658.30	5308.599	19	234.72	6
2/9/2005 14:51	351	2/9/2005 16:45	662347.61	4954.691	20	154.22	11
5/11/2005 22:35	184	5/12/2005 0:00	616659.34	4612.920	21	136.45	14
9/29/2005 5:15	169	9/29/2005 5:45	558250.98	4175.996	22	200.78	7
5/28/2005 8:25	718	5/28/2005 9:30	550537.10	4118.293	23	99.02	23
6/11/2005 17:25	146	6/11/2005 18:00	428953.55	3208.787	24	242.98	5
10/7/2005 7:10	402	10/7/2005 11:00	395690.54	2959.963	25	89.12	27
2/16/2005 7:00	305	2/16/2005 8:20	313778.51	2347.220	26	55.91	33
7/21/2005 14:20	167	7/21/2005 14:45	289055.79	2162.282	27	161.91	10
5/23/2005 16:15	125	5/23/2005 16:30	270941.20	2026.776	28	114.39	20
11/1/2005 14:50	237	11/1/2005 16:35	248490.42	1858.833	29	55.08	34
7/17/2005 16:05	145	7/17/2005 17:20	233522.35	1746.864	30	54.51	35
3/27/2005 16:50	155	3/27/2005 18:05	215151.92	1609.444	31	48.04	37
11/16/2005 4:05	534	11/16/2005 4:15	214327.46	1603.277	32	38.45	41

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
11/9/2005 19:15	129	11/9/2005 19:45	205438.88	1536.786	33	132.60	15
9/26/2005 5:40	338	9/26/2005 9:50	187627.12	1403.545	34	43.03	39
9/16/2005 21:30	95	9/16/2005 22:30	148362.01	1109.822	35	42.67	40
8/8/2005 8:40	109	8/8/2005 9:45	139897.30	1046.502	36	43.93	38
8/27/2005 15:15	103	8/27/2005 15:30	124629.23	932.289	37	103.34	22
5/20/2005 2:41	503	5/20/2005 8:35	124204.01	929.108	38	19.56	48
12/31/2005 23:00	60	12/31/2005 23:05	116486.95	871.381	39	35.10	42
12/25/2005 10:45	224	12/25/2005 13:15	101802.89	761.537	40	27.95	44
6/3/2005 8:01	144	6/3/2005 9:30	82962.95	620.604	41	26.50	45
7/25/2005 13:15	290	7/25/2005 13:30	72107.64	539.401	42	97.60	24
4/30/2005 4:35	207	4/30/2005 6:50	62863.39	470.250	43	20.26	47
7/12/2005 19:16	113	7/12/2005 19:50	62071.73	464.328	44	68.03	29
11/9/2005 4:15	78	11/9/2005 4:30	51525.64	385.438	45	64.81	30
6/14/2005 18:55	105	6/14/2005 19:30	48907.79	365.855	46	14.41	50
10/21/2005 7:15	120	10/21/2005 7:30	37399.41	279.766	47	14.47	49
8/26/2005 20:50	147	8/26/2005 21:00	35267.12	263.816	48	28.12	43
4/20/2005 19:20	298	4/20/2005 21:30	29010.42	217.012	49	7.21	52
6/28/2005 18:05	86	6/28/2005 18:15	26693.69	199.682	50	54.37	36
5/7/2005 12:05	147	5/7/2005 13:30	20929.26	156.561	51	20.95	46
11/8/2005 14:25	108	11/8/2005 15:15	15447.02	115.551	52	6.77	53
4/27/2005 0:15	107	4/27/2005 1:00	9519.02	71.207	53	4.13	54
5/30/2005 19:30	92	5/30/2005 19:55	7639.99	57.151	54	3.40	56
9/23/2005 2:45	39	9/23/2005 3:00	6129.57	45.852	55	10.25	51
8/5/2005 10:56	77	8/5/2005 11:30	2791.79	20.884	56	1.51	57
11/24/2005 8:01	261	11/24/2005 9:15	2738.99	20.489	57	0.46	64
1/30/2005 3:12	717	1/30/2005 14:55	1973.82	14.765	58	0.92	61
10/24/2005 1:46	135	10/24/2005 3:05	1685.44	12.608	59	0.48	63
3/24/2005 9:35	28	3/24/2005 9:45	1678.43	12.555	60	3.91	55
3/20/2005 3:52	285	3/20/2005 7:20	1654.31	12.375	61	1.47	59
3/7/2005 22:24	357	3/8/2005 1:45	1227.29	9.181	62	0.29	65
10/26/2005 7:20	108	10/26/2005 7:30	1083.31	8.104	63	1.50	58
12/26/2005 5:07	405	12/26/2005 6:30	906.67	6.782	64	0.29	66
2/26/2005 11:13	177	2/26/2005 14:00	739.37	5.531	65	0.14	72
4/24/2005 15:06	917	4/25/2005 0:00	722.30	5.403	66	0.14	70
11/23/2005 19:47	41	11/23/2005 20:15	622.27	4.655	67	0.53	62
1/22/2005 10:22	89	1/22/2005 11:15	589.88	4.413	68	0.27	67
11/6/2005 13:45	24	11/6/2005 14:00	566.20	4.235	69	1.18	60
12/4/2005 6:34	496	12/4/2005 6:45	256.75	1.921	70	0.27	68
6/17/2005 1:25	67	6/17/2005 1:30	241.19	1.804	71	0.20	69
2/8/2005 5:51	91	2/8/2005 6:00	160.66	1.202	72	0.14	71
8/16/2005 6:47	16	8/16/2005 7:00	55.30	0.414	73	0.07	74
3/11/2005 14:07	14	3/11/2005 14:15	44.78	0.335	74	0.07	73
2/24/2005 21:27	9	2/24/2005 21:30	28.32	0.212	75	0.07	75
4/24/2005 7:27	8	4/24/2005 7:30	20.70	0.155	76	0.05	76

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	SMR-1a
Structures within Region	#N/A
Model ID	SMR-1a.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	77
Peak Volume:	20,433,097 ft^3
	152.85 MG
Total Volume:	63,162,851 ft^3
	472.49 MG
Peak Rate:	751.49 cfs

Figure 1 - SMR-1a Region CSO Volume

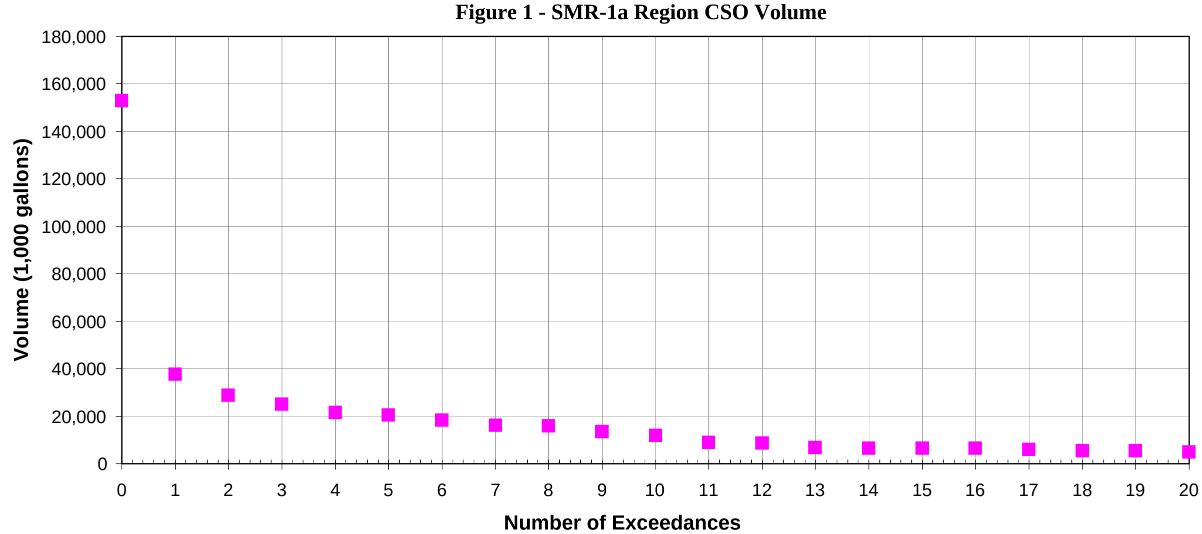
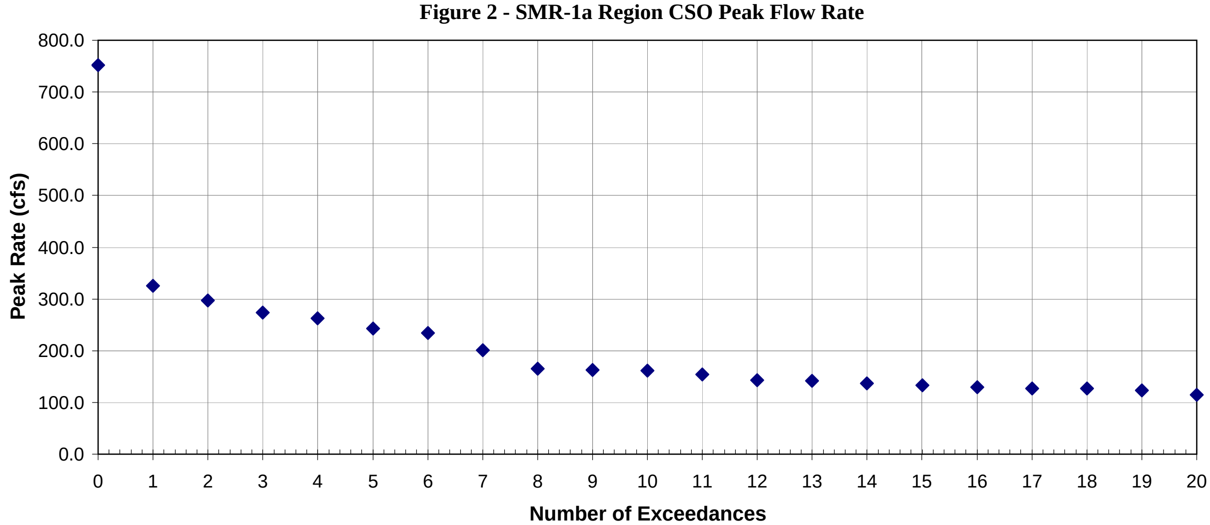


Figure 2 - SMR-1a Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	SMR-1b	**Results Summary**	
Structures within Region	#N/A	Number of Events:	82
Model ID	SMR-1b.1	Peak Volume:	21,199,210 ft^3
Structure Type			158.58 MG
PWSA Sewershed		Total Volume:	66,330,995 ft^3
Stream of Discharge			496.19 MG
NPDES Permit Number		Peak Rate:	835.11 cfs
Owner			

Model Network (07/19/07) Baseline Conditions#2 - FINAL!#1_1#2

Model Run 2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/3/2005 4:19	9664	1/5/2005 14:45	21199210.02	158580.691	0	177.30	10
1/11/2005 7:55	6405	1/12/2005 1:30	7046109.33	52708.421	1	155.27	13
2/14/2005 4:35	4777	2/14/2005 10:00	4249691.31	31789.816	2	94.27	25
3/28/2005 8:50	3493	3/28/2005 19:15	3444110.18	25763.666	3	136.40	18
11/29/2005 1:40	1792	11/29/2005 11:15	2977482.99	22273.062	4	151.98	14
5/13/2005 22:15	2823	5/13/2005 22:45	2946172.93	22038.847	5	368.49	2
10/24/2005 11:22	2226	10/25/2005 2:30	2515632.02	18818.185	6	63.30	32
8/20/2005 18:15	232	8/20/2005 19:00	2304107.12	17235.873	7	835.11	0
4/1/2005 19:15	3646	4/2/2005 7:00	2206888.35	16508.628	8	114.00	22
11/14/2005 21:39	870	11/15/2005 3:45	1679477.82	12563.334	9	177.59	9
7/5/2005 16:15	198	7/5/2005 16:45	1276853.99	9551.506	10	310.47	5
12/15/2005 8:35	2236	12/15/2005 14:00	1209875.93	9050.477	11	104.83	24
7/26/2005 19:30	495	7/26/2005 20:00	971739.21	7269.095	12	418.26	1
2/20/2005 15:20	2583	2/20/2005 20:30	947689.00	7089.188	13	137.98	17
10/21/2005 18:40	1778	10/22/2005 7:00	936477.22	7005.318	14	83.24	27
4/22/2005 15:45	1229	4/23/2005 4:00	935060.44	6994.720	15	139.21	16
7/15/2005 17:22	171	7/15/2005 18:15	876686.42	6558.053	16	316.19	4
8/29/2005 8:45	465	8/29/2005 13:45	748098.12	5596.148	17	243.61	7
3/23/2005 2:20	850	3/23/2005 12:45	737458.65	5516.559	18	63.16	33
2/9/2005 14:50	1613	2/9/2005 16:45	695834.63	5205.191	19	170.45	11
5/11/2005 22:30	191	5/12/2005 0:00	675442.95	5052.651	20	149.07	15
9/29/2005 5:00	185	9/29/2005 5:45	616890.98	4614.653	21	255.07	6
5/28/2005 8:15	826	5/28/2005 9:30	579685.36	4336.336	22	105.36	23
6/11/2005 17:21	152	6/11/2005 17:45	545184.53	4078.253	23	342.57	3
10/7/2005 7:10	623	10/7/2005 11:00	416098.78	3112.627	24	93.53	26
7/21/2005 14:15	174	7/21/2005 14:45	334811.08	2504.554	25	197.69	8
5/23/2005 16:15	125	5/23/2005 16:30	298976.64	2236.495	26	128.39	19
7/17/2005 16:05	145	7/17/2005 16:30	265766.76	1988.068	27	74.77	28
11/1/2005 14:50	239	11/1/2005 16:35	259295.23	1939.658	28	56.25	35
11/16/2005 4:00	540	11/16/2005 4:15	232055.82	1735.894	29	59.01	34
11/9/2005 19:15	130	11/9/2005 19:45	226898.30	1697.313	30	155.67	12
3/27/2005 16:45	160	3/27/2005 18:00	223361.27	1670.854	31	48.54	36
9/26/2005 5:30	348	9/26/2005 9:45	207548.66	1552.568	32	47.48	37

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
9/16/2005 21:01	228	9/16/2005 21:45	156097.55	1167.688	33	42.97	39
8/27/2005 15:00	119	8/27/2005 15:30	154379.05	1154.832	34	125.77	20
8/8/2005 8:30	120	8/8/2005 9:45	145495.55	1088.379	35	43.95	38
5/20/2005 2:05	599	5/20/2005 8:35	134561.27	1006.586	36	20.10	48
12/31/2005 23:00	60	12/31/2005 23:05	116558.51	871.916	37	35.12	41
12/25/2005 10:45	225	12/25/2005 13:15	109184.24	816.753	38	28.50	42
6/3/2005 8:00	145	6/3/2005 9:30	88681.90	663.385	39	26.55	44
7/25/2005 13:15	290	7/25/2005 13:30	84646.28	633.196	40	119.17	21
4/30/2005 4:20	303	4/30/2005 6:45	73704.85	551.349	41	20.76	46
7/12/2005 19:15	114	7/12/2005 19:50	62354.43	466.442	42	68.05	30
6/14/2005 18:45	118	6/14/2005 19:15	59326.08	443.789	43	20.38	47
11/9/2005 4:15	79	11/9/2005 4:30	55210.80	413.004	44	70.04	29
10/21/2005 7:00	138	10/21/2005 7:30	46242.43	345.916	45	19.58	49
8/26/2005 20:45	154	8/26/2005 21:00	43040.85	321.967	46	37.16	40
4/20/2005 19:20	300	4/20/2005 19:45	32752.20	245.003	47	7.96	52
6/28/2005 18:00	93	6/28/2005 18:15	32620.71	244.019	48	67.51	31
5/7/2005 12:05	149	5/7/2005 13:30	28893.46	216.138	49	27.99	43
11/8/2005 10:54	320	11/8/2005 15:15	19483.53	145.747	50	7.32	53
5/30/2005 19:15	109	5/30/2005 19:30	18554.98	138.801	51	8.53	51
11/6/2005 9:45	269	11/6/2005 10:00	15909.55	119.011	52	22.08	45
4/26/2005 21:41	283	4/27/2005 1:00	12606.72	94.305	53	4.59	54
9/23/2005 2:45	40	9/23/2005 3:00	6883.95	51.495	54	11.72	50
8/5/2005 10:55	114	8/5/2005 11:30	5880.38	43.988	55	3.66	56
11/24/2005 5:18	426	11/24/2005 8:15	5297.65	39.629	56	1.22	59
1/30/2005 3:10	719	1/30/2005 14:55	4636.87	34.686	57	0.95	61
4/24/2005 2:36	1743	4/24/2005 16:30	4619.41	34.555	58	0.31	72
3/20/2005 3:40	309	3/20/2005 7:15	3639.44	27.225	59	2.39	57
3/7/2005 22:20	377	3/8/2005 1:45	3062.96	22.912	60	0.40	69
10/24/2005 1:42	141	10/24/2005 3:00	2943.11	22.016	61	0.86	63
12/26/2005 2:40	578	12/26/2005 6:30	2920.23	21.845	62	0.58	65
11/23/2005 19:04	195	11/23/2005 20:15	1960.16	14.663	63	0.90	62
3/24/2005 9:35	36	3/24/2005 9:45	1740.81	13.022	64	3.93	55
10/26/2005 7:20	216	10/26/2005 7:30	1701.32	12.727	65	1.77	58
2/26/2005 11:10	264	2/26/2005 14:00	1635.40	12.234	66	0.31	71
12/4/2005 5:48	547	12/4/2005 6:45	1378.55	10.312	67	0.55	66
1/22/2005 10:17	100	1/22/2005 11:15	1353.84	10.127	68	0.65	64
6/16/2005 11:38	101	6/16/2005 13:00	1122.59	8.398	69	0.95	60
2/8/2005 5:46	411	2/8/2005 6:00	988.04	7.391	70	0.38	70
6/17/2005 1:22	74	6/17/2005 1:30	680.45	5.090	71	0.50	68
8/16/2005 6:45	107	8/16/2005 8:15	584.43	4.372	72	0.50	67
2/24/2005 19:15	144	2/24/2005 21:30	276.99	2.072	73	0.09	77
3/11/2005 14:00	25	3/11/2005 14:15	143.96	1.077	74	0.18	74
8/28/2005 11:50	14	8/28/2005 12:00	127.46	0.953	75	0.21	73
6/6/2005 9:35	29	6/6/2005 10:00	123.68	0.925	76	0.15	75
12/11/2005 19:12	42	12/11/2005 19:45	121.28	0.907	77	0.10	76
6/22/2005 5:20	58	6/22/2005 5:30	120.14	0.899	78	0.09	78
3/20/2005 15:42	12	3/20/2005 15:50	31.93	0.239	79	0.06	79
1/26/2005 10:04	13	1/26/2005 10:15	24.88	0.186	80	0.03	81
9/16/2005 8:54	8	9/16/2005 9:00	17.85	0.134	81	0.04	80

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	SMR-1b
Structures within Region	#N/A
Model ID	SMR-1b.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	82
Peak Volume:	21,199,210 ft^3
	158.58 MG
Total Volume:	66,330,995 ft^3
	496.19 MG
Peak Rate:	835.11 cfs

Figure 1 - SMR-1b Region CSO Volume

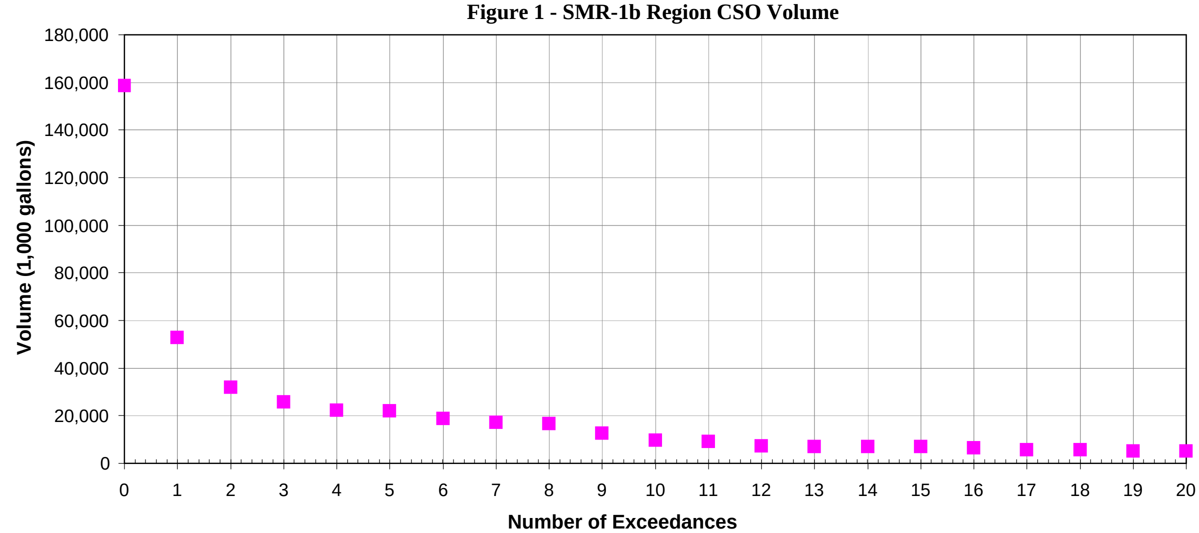
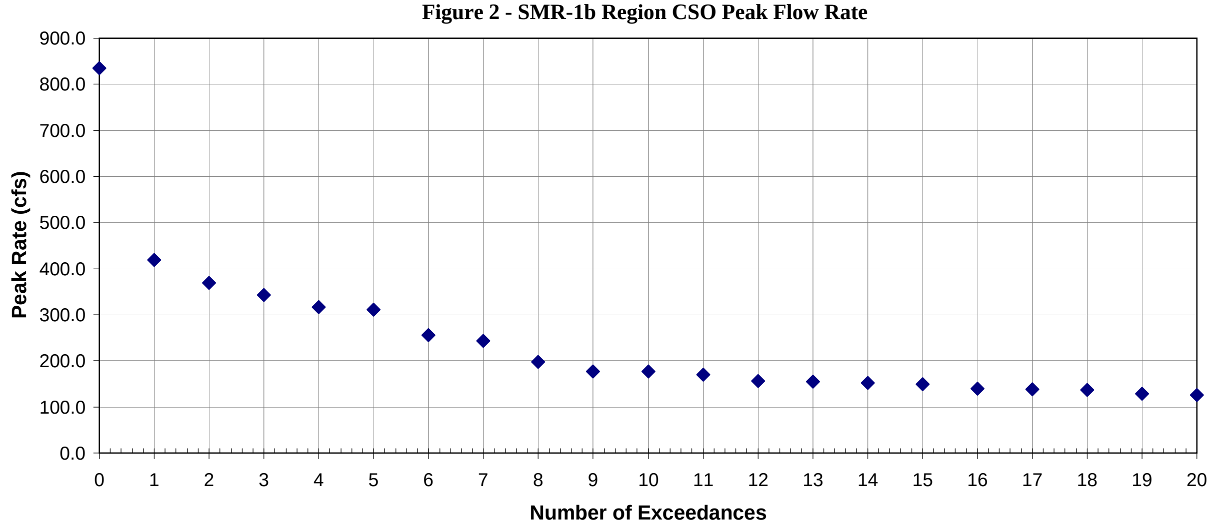


Figure 2 - SMR-1b Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	SMR-2a
Structures within Region	#N/A
Model ID	SMR-2a.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	95
Peak Volume:	22,348,725 ft^3
	167.18 MG
Total Volume:	71,752,452 ft^3
	536.74 MG
Peak Rate:	1030.83 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/3/2005 3:21	8537	1/5/2005 14:45	22348725.28	167179.639	0	201.37	11
1/11/2005 7:36	2374	1/12/2005 1:30	5486952.62	41045.149	1	173.00	17
2/14/2005 4:06	2268	2/14/2005 10:00	4092893.95	30616.893	2	101.09	30
3/28/2005 8:47	1631	3/28/2005 19:15	3661231.44	27387.842	3	184.84	14
5/13/2005 22:25	2265	5/13/2005 22:45	3249481.75	24307.748	4	504.41	1
11/29/2005 1:37	1558	11/29/2005 11:15	3146510.37	23537.471	5	168.00	19
8/20/2005 18:15	225	8/20/2005 19:00	2813285.02	21044.779	6	1030.83	0
10/24/2005 10:50	2897	10/25/2005 2:30	2621862.78	19612.845	7	67.23	34
4/1/2005 18:50	2739	4/2/2005 6:45	2340052.13	17504.760	8	123.82	25
1/13/2005 21:36	1461	1/14/2005 2:15	1955745.53	14629.954	9	143.56	24
11/14/2005 21:27	638	11/15/2005 4:00	1801490.97	13476.053	10	199.27	12
7/5/2005 16:15	195	7/5/2005 16:45	1526213.98	11416.844	11	426.70	3
12/15/2005 8:15	1125	12/15/2005 14:00	1266177.25	9471.639	12	117.63	27
10/21/2005 18:40	1753	10/22/2005 6:45	1257277.26	9405.063	13	288.69	6
7/26/2005 19:35	489	7/26/2005 20:00	1129261.15	8447.438	14	481.09	2
2/20/2005 14:51	1404	2/20/2005 20:30	1034503.41	7738.603	15	168.29	18
4/22/2005 14:51	1278	4/23/2005 4:15	1018576.43	7619.461	16	158.71	20
7/15/2005 17:15	175	7/15/2005 18:15	923880.36	6911.087	17	298.78	5
8/29/2005 9:00	448	8/29/2005 13:45	846395.62	6331.462	18	274.39	7
5/11/2005 22:30	189	5/11/2005 22:45	790735.85	5915.100	19	204.28	9
3/23/2005 1:51	829	3/23/2005 12:45	781857.12	5848.682	20	68.22	33
2/9/2005 14:20	395	2/9/2005 16:45	769829.83	5758.712	21	203.98	10
9/29/2005 5:00	184	9/29/2005 5:45	693799.52	5189.967	22	304.44	4
5/28/2005 7:50	753	5/28/2005 9:30	630328.05	4715.169	23	122.25	26
10/7/2005 7:07	627	10/7/2005 10:45	455212.63	3405.218	24	104.39	29
6/11/2005 17:25	146	6/11/2005 18:00	434737.76	3252.056	25	243.31	8
7/21/2005 14:20	167	7/21/2005 14:45	378419.89	2830.770	26	174.35	15
7/17/2005 16:05	145	7/17/2005 16:30	360621.77	2697.631	27	190.84	13
2/16/2005 5:36	743	2/16/2005 8:15	337801.07	2526.921	28	60.97	36
5/23/2005 16:15	125	5/23/2005 16:45	330706.93	2473.853	29	149.03	22
11/16/2005 4:00	539	11/16/2005 4:15	288918.21	2161.253	30	108.11	28
9/16/2005 21:15	110	9/16/2005 21:45	282367.57	2112.251	31	146.46	23
11/1/2005 14:36	251	11/1/2005 16:35	276675.19	2069.669	32	59.49	37

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	**Exceedance Duration (minutes)**	**Time of Peak Flow**	**(ft^3)**	**(1,000 gallons)**	**Number of Exceedances**	**(cfs)**	**Number of Exceedances**
3/27/2005 16:16	188	3/27/2005 18:00	247394.42	1850.634	33	50.03	41
9/26/2005 5:25	353	9/26/2005 9:45	239578.12	1792.164	34	51.51	40
11/9/2005 19:15	129	11/9/2005 19:45	217365.41	1626.002	35	149.33	21
8/8/2005 8:20	130	8/8/2005 9:15	198550.71	1485.259	36	51.73	39
8/27/2005 15:00	117	8/27/2005 15:30	194026.11	1451.412	37	173.01	16
5/20/2005 2:05	539	5/20/2005 8:35	153859.99	1150.950	38	20.50	50
12/31/2005 23:00	60	12/31/2005 23:05	116486.95	871.381	39	35.10	44
7/25/2005 13:15	328	7/25/2005 13:30	114423.29	855.943	40	98.23	31
12/25/2005 10:31	238	12/25/2005 13:15	114409.25	855.838	41	28.44	45
6/3/2005 5:56	269	6/3/2005 9:30	108183.10	809.264	42	27.96	47
7/12/2005 19:16	113	7/12/2005 20:00	92668.37	693.206	43	75.97	32
4/30/2005 4:16	226	4/30/2005 6:50	80118.63	599.327	44	21.35	49
6/14/2005 18:50	110	6/14/2005 19:15	69741.48	521.701	45	38.12	42
10/21/2005 1:45	450	10/21/2005 7:30	56543.05	422.970	46	24.57	48
11/9/2005 4:15	289	11/9/2005 4:30	54196.09	405.414	47	65.34	35
8/26/2005 19:50	464	8/26/2005 21:00	51344.08	384.079	48	28.25	46
5/7/2005 11:35	177	5/7/2005 13:30	37966.64	284.009	49	37.48	43
4/20/2005 19:20	298	4/20/2005 19:45	37094.32	277.484	50	9.83	55
6/28/2005 18:05	86	6/28/2005 18:15	26773.34	200.278	51	54.37	38
11/8/2005 10:35	337	11/8/2005 15:15	25635.84	191.769	52	10.18	54
1/30/2005 3:12	717	1/30/2005 14:00	20193.52	151.058	53	9.68	56
4/26/2005 19:51	371	4/27/2005 0:45	19951.12	149.244	54	8.85	58
5/30/2005 19:30	92	5/30/2005 20:00	12245.33	91.601	55	10.33	53
1/26/2005 3:10	179	1/26/2005 5:00	11772.01	88.061	56	2.72	63
3/7/2005 21:15	444	3/7/2005 22:10	10946.42	81.885	57	1.27	75
11/24/2005 7:51	272	11/24/2005 8:15	10259.37	76.745	58	2.26	65
6/6/2005 9:45	34	6/6/2005 10:00	10036.37	75.077	59	19.87	51
6/8/2005 21:00	56	6/8/2005 21:15	9096.07	68.043	60	9.64	57
8/5/2005 10:51	82	8/5/2005 11:30	8118.15	60.728	61	7.33	60
4/24/2005 7:27	1452	4/25/2005 6:30	7767.09	58.102	62	1.35	73
9/23/2005 2:45	39	9/23/2005 3:00	7313.95	54.712	63	12.83	52
12/26/2005 1:21	663	12/26/2005 11:45	7053.08	52.761	64	0.86	81
6/16/2005 11:11	337	6/16/2005 13:15	6539.03	48.915	65	7.77	59
10/24/2005 1:46	135	10/24/2005 3:00	6449.42	48.245	66	2.13	67
10/28/2005 11:56	53	10/28/2005 12:30	4581.43	34.271	67	4.22	61
11/23/2005 18:51	213	11/23/2005 20:15	4050.59	30.300	68	1.94	70
3/20/2005 3:30	334	3/20/2005 7:20	3826.04	28.621	69	2.04	68
6/17/2005 0:45	108	6/17/2005 1:30	2346.45	17.553	70	1.59	72
3/12/2005 10:50	118	3/12/2005 12:30	2098.51	15.698	71	2.70	64
3/11/2005 8:06	377	3/11/2005 14:00	2069.53	15.481	72	1.19	76
2/25/2005 12:51	259	2/25/2005 16:00	1759.61	13.163	73	1.07	79
7/16/2005 11:15	93	7/16/2005 11:30	1707.68	12.774	74	1.07	78
3/24/2005 9:35	28	3/24/2005 9:45	1678.45	12.556	75	3.91	62
8/16/2005 5:50	168	8/16/2005 8:15	1639.94	12.268	76	1.08	77
6/22/2005 5:06	37	6/22/2005 5:30	1552.96	11.617	77	1.90	71
12/9/2005 3:50	73	12/9/2005 4:30	1414.19	10.579	78	0.66	83
2/26/2005 11:13	177	2/26/2005 12:45	1285.16	9.614	79	0.88	80
11/6/2005 13:45	25	11/6/2005 14:00	1183.77	8.855	80	1.99	69
7/12/2005 12:16	26	7/12/2005 12:30	948.84	7.098	81	1.31	74
6/29/2005 20:35	19	6/29/2005 20:45	871.27	6.518	82	2.20	66
1/22/2005 10:22	89	1/22/2005 11:15	589.89	4.413	83	0.27	86
12/16/2005 14:31	28	12/16/2005 14:45	541.06	4.047	84	0.80	82
2/8/2005 5:39	103	2/8/2005 6:00	511.72	3.828	85	0.53	84
5/19/2005 19:27	25	5/19/2005 19:45	348.00	2.603	86	0.39	85

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
12/4/2005 6:34	496	12/4/2005 6:45	256.80	1.921	87	0.27	87

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
5/24/2005 6:20	343	5/24/2005 6:30	192.69	1.441	88	0.20	89
3/20/2005 16:10	21	3/20/2005 16:15	135.20	1.011	89	0.19	90
11/14/2005 0:05	13	11/14/2005 0:15	105.62	0.790	90	0.20	88
5/27/2005 20:48	14	5/27/2005 21:00	38.94	0.291	91	0.06	94
7/18/2005 18:41	11	7/18/2005 18:45	36.62	0.274	92	0.09	91
2/24/2005 21:27	9	2/24/2005 21:30	28.33	0.212	93	0.07	93
3/25/2005 12:09	8	3/25/2005 12:15	24.37	0.182	94	0.07	92

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	SMR-2a	**Results Summary**	
Structures within Region	#N/A	Number of Events:	95
Model ID	SMR-2a.1	Peak Volume:	22,348,725 ft^3
Structure Type			167.18 MG
PWSA Sewershed		Total Volume:	71,752,452 ft^3
Stream of Discharge			536.74 MG
NPDES Permit Number		Peak Rate:	1030.83 cfs
Owner			

Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Figure 1 - SMR-2a Region CSO Volume

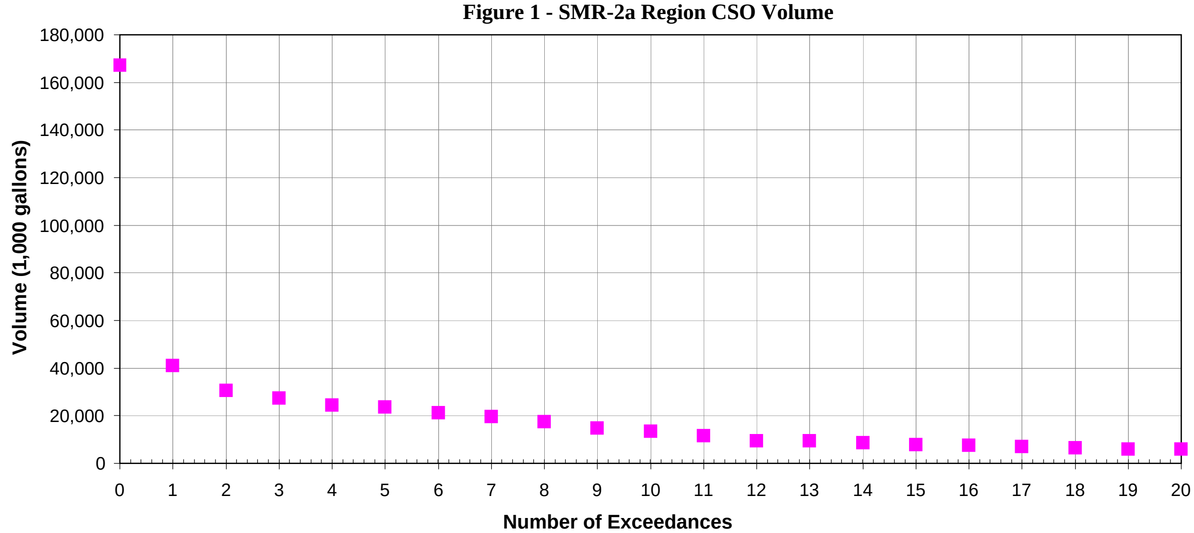
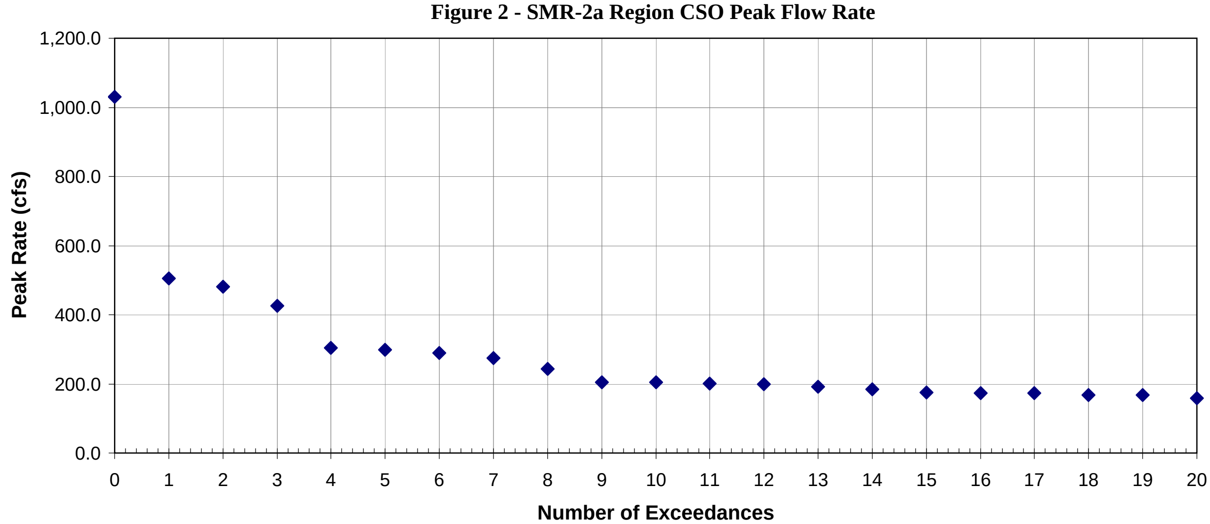


Figure 2 - SMR-2a Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	SMR-2b
Structures within Region	#N/A
Model ID	SMR-2b.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	

Results Summary

Number of Events:	97
Peak Volume:	23,114,929 ft^3
	172.91 MG
Total Volume:	74,930,449 ft^3
	560.52 MG
Peak Rate:	1114.45 cfs

Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/3/2005 3:20	9841	1/5/2005 14:45	23114928.64	172911.224	0	215.45	12
1/11/2005 7:35	6625	1/12/2005 1:30	7664540.75	57334.597	1	185.13	18
2/14/2005 4:05	5132	2/14/2005 10:00	4509115.76	33730.440	2	103.65	30
3/28/2005 8:45	3691	3/28/2005 19:15	3763350.20	28151.741	3	198.15	15
5/13/2005 22:15	2870	5/13/2005 22:45	3450205.19	25809.260	4	599.78	1
11/29/2005 1:35	1796	11/29/2005 11:15	3248854.52	24303.056	5	178.15	20
8/20/2005 18:15	232	8/20/2005 19:00	2991385.01	22377.056	6	1114.45	0
10/24/2005 10:50	2903	10/25/2005 2:30	2690065.76	20123.037	7	71.56	32
4/1/2005 18:50	3801	4/2/2005 6:45	2394977.88	17915.632	8	128.86	24
11/14/2005 21:25	887	11/15/2005 4:00	1895370.26	14178.317	9	206.55	14
7/5/2005 16:15	198	7/5/2005 16:45	1644252.96	12299.834	10	512.48	3
10/21/2005 18:40	1780	10/22/2005 6:45	1329545.98	9945.669	11	301.75	7
12/15/2005 8:15	2292	12/15/2005 14:00	1304414.62	9757.674	12	127.12	27
7/26/2005 19:30	495	7/26/2005 20:00	1248962.34	9342.863	13	573.96	2
4/22/2005 14:50	1299	4/23/2005 4:00	1089976.41	8153.569	14	191.83	17
2/20/2005 14:50	2746	2/20/2005 20:30	1068855.82	7995.576	15	178.97	19
7/15/2005 17:15	178	7/15/2005 18:00	1009182.49	7549.190	16	343.56	6
8/29/2005 8:45	465	8/29/2005 13:45	884836.05	6619.016	17	283.28	8
5/11/2005 22:30	191	5/11/2005 22:45	849515.96	6354.804	18	242.81	9
3/23/2005 1:50	884	3/23/2005 12:45	808933.22	6051.225	19	71.11	33
2/9/2005 14:16	1821	2/9/2005 16:45	803820.35	6012.978	20	220.21	11
9/29/2005 5:00	186	9/29/2005 5:45	752440.89	5628.634	21	358.73	4
5/28/2005 7:50	851	5/28/2005 9:30	659509.65	4933.462	22	128.60	26
6/11/2005 17:21	152	6/11/2005 17:45	550968.74	4121.522	23	351.54	5
10/7/2005 7:05	630	10/7/2005 10:45	475629.18	3557.944	24	112.75	29
7/21/2005 14:15	174	7/21/2005 14:45	424175.20	3173.043	25	210.13	13
7/17/2005 16:05	145	7/17/2005 16:30	392866.19	2938.836	26	231.79	10
5/23/2005 16:15	125	5/23/2005 16:45	358742.37	2683.572	27	171.42	22
11/16/2005 4:00	540	11/16/2005 4:15	306646.66	2293.870	28	128.67	25
9/16/2005 21:01	230	9/16/2005 21:45	290107.98	2170.153	29	152.85	23
11/1/2005 14:35	253	11/1/2005 16:30	287497.19	2150.623	30	62.10	36
9/26/2005 5:25	354	9/26/2005 9:45	259506.17	1941.236	31	57.36	37
3/27/2005 16:15	233	3/27/2005 18:00	255728.59	1912.978	32	51.02	39

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
11/9/2005 19:15	130	11/9/2005 19:45	238824.81	1786.529	33	172.40	21
8/27/2005 15:00	119	8/27/2005 15:30	223773.97	1673.941	34	195.43	16
8/8/2005 8:20	130	8/8/2005 9:15	204160.74	1527.224	35	52.28	38
5/20/2005 2:05	599	5/20/2005 8:35	164218.75	1228.438	36	21.05	49
7/25/2005 13:15	329	7/25/2005 13:30	127009.01	950.091	37	119.80	28
12/25/2005 10:30	240	12/25/2005 13:15	121810.37	911.202	38	29.00	45
12/31/2005 23:00	60	12/31/2005 23:05	116558.52	871.916	39	35.12	43
6/3/2005 5:55	271	6/3/2005 9:30	114049.16	853.145	40	28.01	46
7/12/2005 19:15	114	7/12/2005 20:00	92951.08	695.321	41	76.11	31
4/30/2005 4:15	309	4/30/2005 6:45	90969.26	680.496	42	23.07	47
6/14/2005 18:45	118	6/14/2005 19:15	80159.63	599.634	43	45.75	40
10/21/2005 1:45	453	10/21/2005 7:30	65713.48	491.570	44	29.68	44
8/26/2005 19:50	465	8/26/2005 21:00	59447.15	444.694	45	37.29	42
11/9/2005 4:15	289	11/9/2005 4:30	58131.48	434.853	46	70.57	34
5/7/2005 11:35	179	5/7/2005 13:30	45969.23	343.873	47	44.52	41
4/20/2005 19:20	300	4/20/2005 19:45	40836.13	305.475	48	11.43	53
6/28/2005 18:00	93	6/28/2005 18:15	32700.35	244.615	49	67.51	35
11/8/2005 10:35	339	11/8/2005 15:15	29667.80	221.930	50	10.72	54
4/26/2005 19:50	397	4/27/2005 0:45	23199.27	173.542	51	10.62	55
5/30/2005 19:15	109	5/30/2005 20:00	23160.38	173.251	52	12.18	52
1/30/2005 3:10	723	1/30/2005 14:00	22863.50	171.030	53	10.09	56
11/6/2005 9:45	269	11/6/2005 10:00	16526.58	123.627	54	22.08	48
3/7/2005 21:15	449	3/7/2005 22:30	12889.02	96.416	55	1.48	72
11/24/2005 4:57	447	11/24/2005 8:15	12887.50	96.405	56	3.07	62
1/26/2005 3:10	427	1/26/2005 5:00	12383.76	92.637	57	2.74	64
4/24/2005 2:36	1759	4/25/2005 6:30	11654.04	87.178	58	1.40	73
8/5/2005 10:50	119	8/5/2005 11:30	11217.35	83.911	59	9.47	58
6/6/2005 9:35	44	6/6/2005 10:00	10178.26	76.138	60	20.03	50
12/26/2005 1:20	675	12/26/2005 11:45	9173.89	68.625	61	1.17	76
6/8/2005 21:00	59	6/8/2005 21:15	9167.36	68.576	62	9.66	57
9/23/2005 2:45	40	9/23/2005 3:00	8068.32	60.355	63	14.29	51
6/16/2005 11:10	339	6/16/2005 13:15	7930.93	59.327	64	8.24	59
10/24/2005 1:42	141	10/24/2005 3:00	7707.42	57.655	65	2.56	66
3/20/2005 3:30	340	3/20/2005 7:15	5859.79	43.834	66	2.97	63
11/23/2005 18:50	217	11/23/2005 20:15	5397.34	40.375	67	2.31	67
10/28/2005 11:55	57	10/28/2005 12:30	4647.57	34.766	68	4.24	60
6/17/2005 0:45	112	6/17/2005 1:30	2825.21	21.134	69	1.88	70
3/11/2005 8:05	383	3/11/2005 14:00	2716.06	20.318	70	1.21	75
2/26/2005 11:10	425	2/26/2005 12:45	2469.59	18.474	71	0.95	79
8/16/2005 5:50	201	8/16/2005 8:15	2298.24	17.192	72	1.58	71
3/12/2005 10:50	120	3/12/2005 12:30	2288.88	17.122	73	2.72	65
2/25/2005 12:50	264	2/25/2005 16:00	2176.05	16.278	74	1.09	77
7/16/2005 11:15	94	7/16/2005 11:30	1821.18	13.623	75	1.09	78
3/24/2005 9:35	36	3/24/2005 9:45	1740.86	13.022	76	3.93	61
6/22/2005 5:05	74	6/22/2005 5:30	1701.79	12.730	77	1.98	69
12/9/2005 3:50	74	12/9/2005 4:30	1504.24	11.252	78	0.68	81
12/4/2005 5:48	547	12/4/2005 6:45	1378.60	10.313	79	0.55	83
2/8/2005 5:35	421	2/8/2005 6:00	1358.35	10.161	80	0.77	80
1/22/2005 10:17	100	1/22/2005 11:15	1353.85	10.127	81	0.65	82
7/12/2005 12:15	29	7/12/2005 12:30	984.99	7.368	82	1.33	74
6/29/2005 20:35	20	6/29/2005 20:45	894.55	6.692	83	2.22	68
5/24/2005 6:20	344	5/24/2005 6:30	632.83	4.734	84	0.22	86
5/19/2005 19:25	28	5/19/2005 19:45	388.65	2.907	85	0.41	84
2/24/2005 19:15	144	2/24/2005 21:30	277.02	2.072	86	0.09	91

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
3/20/2005 15:42	53	3/20/2005 16:15	234.33	1.753	87	0.21	87

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
8/28/2005 11:50	14	8/28/2005 12:00	127.47	0.954	88	0.21	88
11/14/2005 0:05	14	11/14/2005 0:15	122.11	0.913	89	0.22	85
12/11/2005 19:12	42	12/11/2005 19:45	121.28	0.907	90	0.10	90
7/18/2005 18:40	21	7/18/2005 18:45	73.55	0.550	91	0.11	89
5/27/2005 20:46	18	5/27/2005 21:00	67.24	0.503	92	0.08	94
3/25/2005 12:05	14	3/25/2005 12:15	51.48	0.385	93	0.09	92
5/21/2005 14:55	9	5/21/2005 15:00	30.25	0.226	94	0.09	93
5/22/2005 20:11	8	5/22/2005 20:15	19.83	0.148	95	0.06	95
9/16/2005 8:54	8	9/16/2005 9:00	17.85	0.134	96	0.04	96

Exceedance Summary

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	SMR-2b
Structures within Region	#N/A
Model ID	SMR-2b.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	97
Peak Volume:	23,114,929 ft^3
	172.91 MG
Total Volume:	74,930,449 ft^3
	560.52 MG
Peak Rate:	1114.45 cfs

Figure 1 - SMR-2b Region CSO Volume

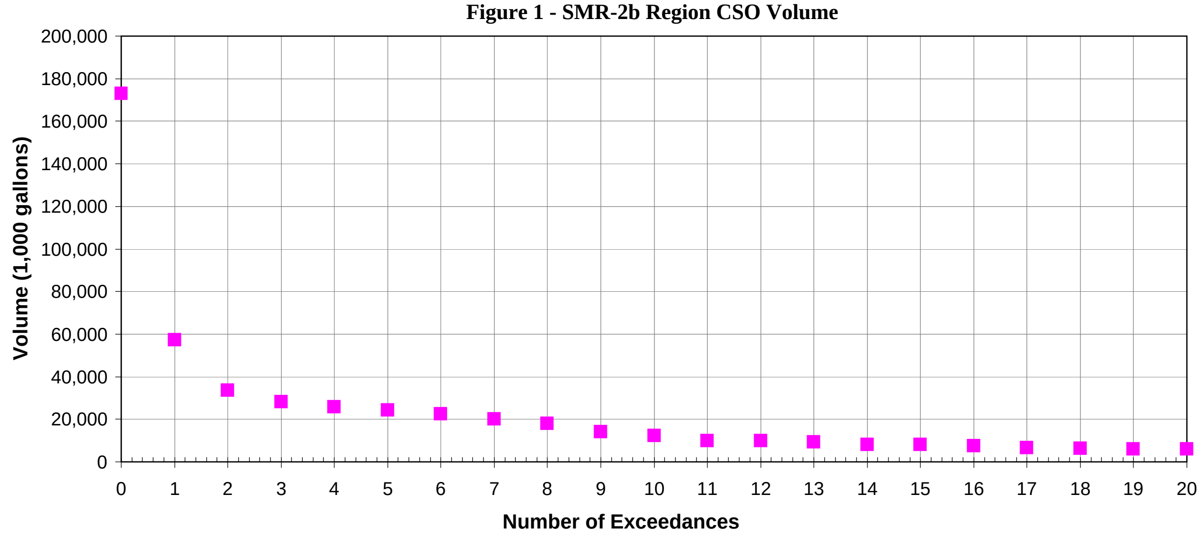
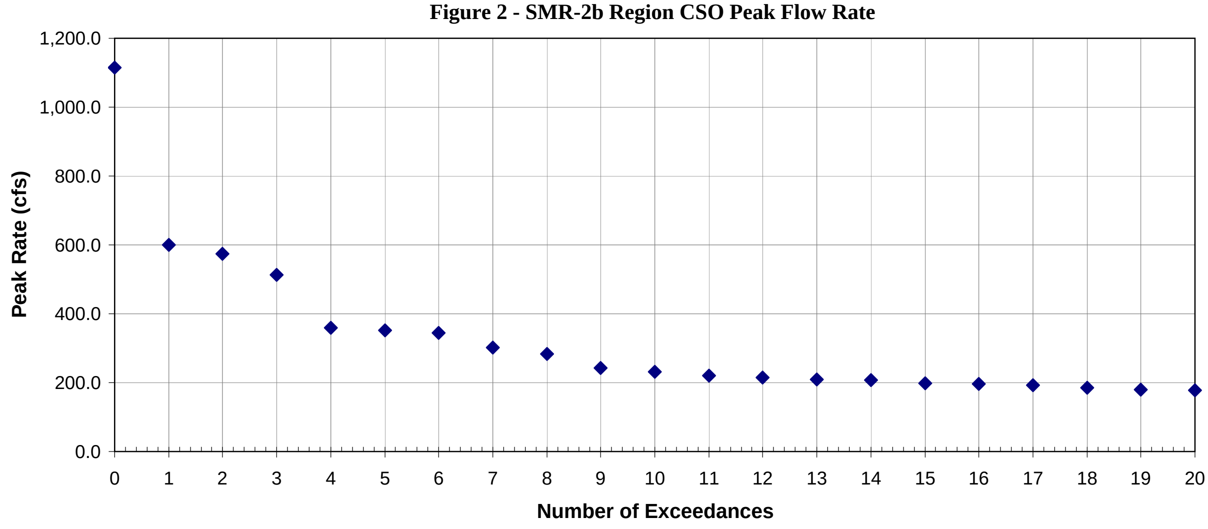


Figure 2 - SMR-2b Region CSO Peak Flow Rate



F.4 SAWMILL RUN SUBSYSTEM

Description of Subsystem

The Sawmill Run Subsystem is located along Sawmill Run from CSO Structure O-14 to the intersection of the Sawmill Run Interceptor and McDonoughs Run. The Sawmill Run Subsystem includes the Sawmill Run Interceptor Sewersheds and the Plummers Run, Bausman, Brook and Warrington, Olympia, Shaler and Woodruff, McCartney Run, Edgebrook, Brookline, McDonoughs Run, Little Sawmill Run, and the Englert and Weyman Sewersheds. Control of CSOs within this Subsystem will be based upon Tunnel Storage, in combination with the highest ranked outfall groupings in the areas not served by the Tunnel. This combination serves to control CSOs originating from the following outfalls and Regions.

- O-14 to S-46 Region
- S-30
- S-31 to S-36 Region
- S-37 to S-42 Region
- CSO 019M001
- CSO 034R001
- CSO 138J001 to 138P001
- CSO 138K001
- S-18 to CSO 095J001 Region
- CSO 097L001 (1)
- CSO 139A001 to 139B002 (1)
- CSO 139B003 (1)
- CSO 139F001 (1)
- CSO 016A001 to 035J001 (2)
- CSO 036R001 (2)
- S-23 to S-29 Region
- DC 034N001 (3)
- DC 035P001 (3)
- DC 035S001 (3)
- DC 035S002 (3)
- DC 062C001 (3)
- DC 062C002 (3)

- DC 062D001 [3]
- DC 062K001 [3]
- DC 062K002 [3]

(1) As a group, these outfalls are known as the McDonoughs Run Region

(2) As a group, these outfalls are known as the Little Sawmill Run Region

(3) These diversion chambers are part of the Plummers Run Region but were addressed separately from the CSO because the CSO includes a large quantity of stream base flow and separate storm flow.

All of these Regions currently convey overflows from each of the respective ALCOSAN diversion chambers to Sawmill Run and, ultimately, the Ohio River.

The entire area that is encompassed in this alternative includes approximately 9,320 acres of residential, business and commercial users.

Description of Alternatives

In an effort to determine the most effective combination of controls for this Subsystem, four variations were developed and evaluated. They are labeled SMR-1a, SMR-1b, SMR-2a and SMR-2b. These subsystem variations were based upon a capture level of 4 CSO events per year. A brief description of each is given below.

Alternative SMR-1a

Alternative SMR-1a is based upon Tunnel SMR-1a having an approximate length of 15,000 feet. *Attachment 1 – Subsystem Alternative SMR-1a Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and approximate location of the tunnel. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows (outlier outfalls) in the Sawmill Run Subsystem will be controlled using the highest ranked CSO control technologies that were identified during the Outfall Specific and Regional Alternatives Evaluation process. Detailed descriptions of these Outfall Specific and Regional Alternatives may be found in Appendices D and E.

Tunnel SMR-1a sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 152.84 MG to 18.32 MG for control levels of 0 to 6 overflow events, respectively. *Figure 1 – SMR-1a Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

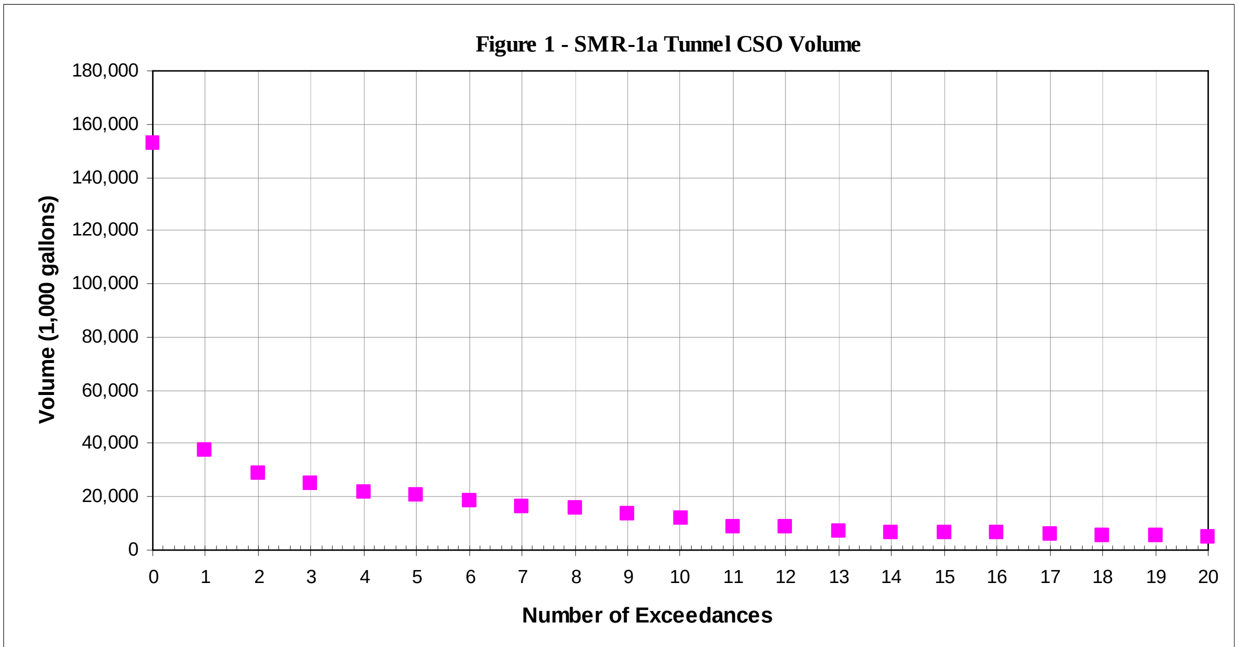


Table 1 – Alternative SMR-1a Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation, sewershed characteristics, and the CSO control technology for each outfall and/or Region not controlled by the tunnel.

Table 1: Alternative SMR-1a Characteristics

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
O-14 to S-46 Region	O-14	6692	78	Tunnel SMR-1a
	O-14A			
	O-14B			
	S-46			
S-30	S-30			
S-31 to S-36 Region	CSO 015P001			
	S-31			
	S-32			

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
	S-33			
	S-34			
	S-35			
	S-36			
S-37 to S-42 Region	CSO 005R001 (S-37 and S-38)			
	S-39			
	ACSO 005F001 (S-40)			
	S-41			
	S-42			
CSO 019M001	CSO 019M001 (S-42A)			
CSO 034R001	CSO 034R001	17	31	Low Flow/Remote (Sewer Separation)
CSO 138J001 to 138P001	CSO 138J001	21	42	Sewer Separation
	CSO 138P001			
CSO 138K001	CSO 138K001	1	0	No Activations
S-18 to CSO 095J001 Region	CSO 095E001	471	71	Sub-Surface Storage
	CSO 095J001			
	S-18			
CSO 097L001	CSO 097L001	51	53	Sub-Surface Storage
CSO 139A001 to 139B002	CSO 139A001	298	80	Sub-Surface Storage
	CSO 139B001			
	CSO 139B002			
CSO 139B003	CSO 139B003	22	31	Low Flow/Remote (Sewer Separation)
CSO 139F001	CSO 139F001	17	0	No Activations
CSO 016A001 to 035J001	CSO 016A001	310	79	Sub-Surface Storage
	CSO 016A002			
	CSO 035A001			
	CSO 035E001			
	CSO 035J001			
CSO 036R001	CSO 036R001	428	82	Sub-Surface Storage
S-23 to S-29 Region	S-23	992	91	Sub-Surface Storage
	S-24			
	S-28			
	S-29			
	CSO 060A001			
DC 034N001	CSO 015P001	8.6	13	Low Flow/Remote (Sewer Separation)
DC 035P001		4.1	10	Low Flow/Remote (Sewer Separation)

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
DC 035S001		3.2	15	Low Flow/Remote (Sewer Separation)
DC 035S002		29.9	NA	Direct Connection to Trunk Sewer
DC 062C001		5.6	4	Low Flow/Remote (Sewer Separation)
DC 062C002		1.7	0	No Activations
DC 062D001		15.3	10	Low Flow/Remote (Sewer Separation)
DC 062K001		2.4	0	No Activations
DC 062K002		4.3	14	Low Flow/Remote (Sewer Separation)

<u>Tunnel SMR-1a</u>

The Sawmill Run Tunnel SMR-1a would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-14 to just south of ALCOSAN diversion chamber S-30. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 22 MGD for 4 overflows. Assuming a tunnel length of approximately 2.8 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level is 19.0 feet.

Other important components of Tunnel SMR-1a include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 2 – Tunnel SMR-1a Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 2: Tunnel SMR-1a Consolidation Sewer and Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
SMR-1	Near O-14	O-14, O-14A, O-14B	132.19	675	78
SMR-2	Near S-46	S-46	46.57	100	48
SMR-3	Near CSO 019M001	CSO 019M001	145.79	5,355	78
SMR-4	Near S-41	S-41	17.48	100	36
SMR-5	Near ACSO 005F001	ACSO 005F001	34.02	100	48
SMR-6	Near CSO 005R001	CSO 005R001 (S-37 and S-38), S-39	383.38	920	120
SMR-7	Near S-36	S-36, S-35, S-33	91.40	2,125	66
SMR-8	Near S-32	S-32	241.65	4,800	96

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM south of O-14. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development; as well as natural features such as Sawmill Run. Approximately 4.6 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 2 – Subsystem Alternative SMR-1a, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

S-18 to CSO 095J001 Region, CSO 097L001, CSO 139A001 to 139B002, CSO 016A001 to 035J001, CSO 036R001, and S-23 to S-29 Region portions of Alternative SMR-1a will be controlled via implementation of Sub-Surface Storage. Sub-Surface Storage facilities consist of a below grade storage unit, in combination with a screening unit, to temporarily store CSO waters. Stored flows from the facility are slowly reintroduced into the collection and conveyance system after the storm event concludes and the system equalizes. Sub-surface storage methods typically consist of closed concrete tanks, and are also equipped with a pump station and odor control measures.

CSO 034R001, CSO 138J001 to 138P001, CSO 139B003, DC 034N001, DC 035P001, DC 035S001, DC 062C001, DC 062D001, and DC 062K002 portions of Alternative SMR-1a will be controlled via implementation of Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall. At the time of design, lower cost small storage technologies could be considered for the overflows identified as "Low Flow/Remote (Sewer Separation)" on the alternative characteristics table.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

Alternative SMR-1b

Alternative SMR-1b is based upon Tunnel SMR-1b having an approximate length of 15,000 feet. *Attachment 3 – Subsystem Alternative SMR-1b Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and approximate location of the tunnel. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows (outlier outfalls) in the Sawmill Run Subsystem will be controlled using the highest ranked CSO control technologies that were identified during the Outfall Specific and Regional Alternatives Evaluation process. Detailed descriptions of these Outfall Specific and Regional Alternatives may be found in Appendices D and E.

Tunnel SMR-1b sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 158.57 MG to 18.82 MG for control levels of 0 to 6 overflow events, respectively. *Figure 2 – SMR-1b Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

Figure 2 - SMR-1b Tunnel CSO Volume

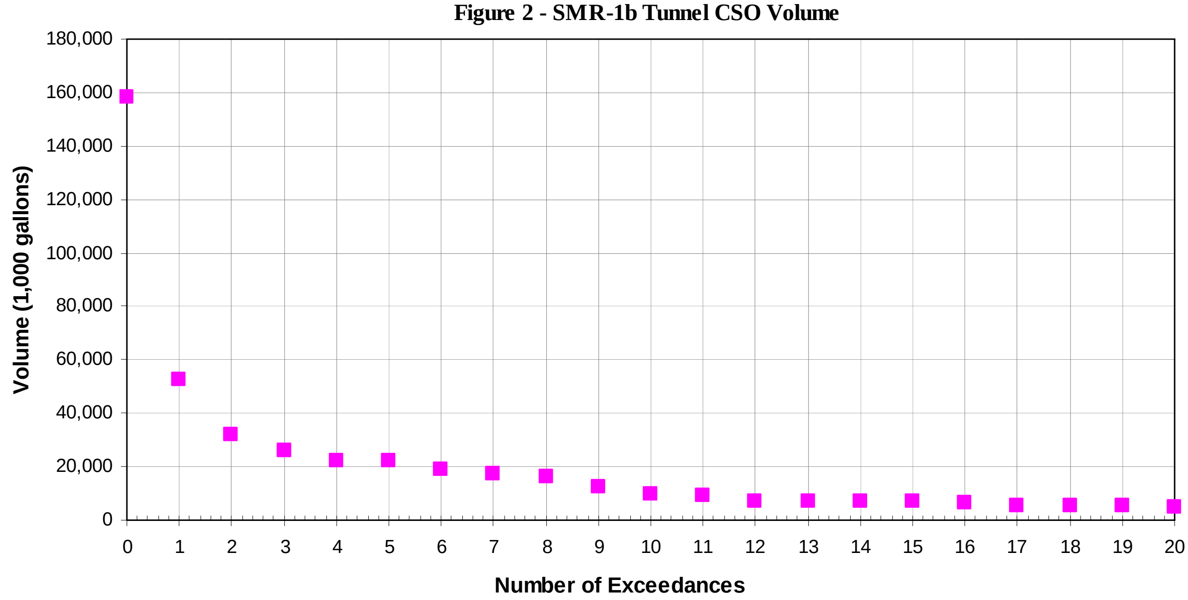


Table 3 – Alternative SMR-1b Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation, sewershed characteristics, and the CSO control technology for each outfall and/or Region not controlled by the tunnel.

Table 3: Alternative SMR-1b Characteristics

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
O-14 to S-46 Region	O-14	7430	82	Tunnel SMR-1a
	O-14A			
	O-14B			
	S-46			
S-30	S-30			
S-31 to S-36 Region	CSO 015P001			
	S-31			
	S-32			
	S-33			
	S-34			
	S-35			
	S-36			
S-37 to S-42 Region	CSO 005R001 (S-37 and S-38)			
	S-39			
	ACSO 005F001 (S-40)			
	S-41			
	S-42			
CSO 019M001	CSO 019M001 (S-42A)			
Little Sawmill Run Region	CSO 016A001			
	CSO 016A002			
	CSO 035A001			
	CSO 035E001			
	CSO 035J001			
	CSO 036R001			
CSO 034R001	CSO 034R001	17	31	Low Flow/Remote (Sewer Separation)
CSO 138J001 to 138P001	CSO 138J001	21	42	Sewer Separation
	CSO 138P001			
CSO 138K001	CSO 138K001	1	0	No Activations
S-18 to CSO 095J001 Region	CSO 095E001	471	71	Sub-Surface Storage
	CSO 095J001			
	S-18			
CSO 097L001	CSO 097L001	51	53	Sub-Surface Storage
CSO 139A001 to 139B002	CSO 139A001	298	80	Sub-Surface Storage
	CSO 139B001			
	CSO 139B002			
CSO 139B003	CSO 139B003	22	31	Sewer Separation
CSO 139F001	CSO 139F001	17	0	No Activations

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
S-23 to S-29 Region	S-23	992	91	Sub-Surface Storage
	S-24			
	S-28			
	S-29			
	CSO 060A001			
DC 034N001	CSO 015P001	8.6	13	Low Flow/Remote (Sewer Separation)
DC 035P001		4.1	10	Low Flow/Remote (Sewer Separation)
DC 035S001		3.2	15	Low Flow/Remote (Sewer Separation)
DC 035S002		29.9	NA	Direct Connection to Trunk Sewer
DC 062C001		5.6	4	Low Flow/Remote (Sewer Separation)
DC 062C002		1.7	0	No Activations
DC 062D001		15.3	10	Low Flow/Remote (Sewer Separation)
DC 062K001		2.4	0	No Activations
DC 062K002		4.3	14	Low Flow/Remote (Sewer Separation)

Tunnel SMR-1b

The Sawmill Run Tunnel SMR-1b would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-14 to just south of ALCOSAN diversion chamber S-30. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 22 MGD for 4 overflows. Assuming a tunnel length of approximately 2.8 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level is 19.0 feet.

Other important components of Tunnel SMR-1b include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 4 – Tunnel SMR-1b Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 4: Tunnel SMR-1b Consolidation Sewer and Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
SMR-1	Near O-14	O-14, O-14A, O-14B	132.19	675	78
SMR-2	Near S-46	S-46	46.57	100	48
SMR-3	Near CSO 019M001	CSO 019M001	145.79	5,355	78
SMR-4	Near S-41	S-41	17.48	100	36
SMR-5	Near ACSO 005F001	ACSO 005F001	199.94	14,960	90
SMR-6	Near CSO 005R001	CSO 005R001 (S-37 and S-38), S-39	383.38	920	120
SMR-7	Near S-36	S-36, S-35, S-33	91.40	2,125	66
SMR-8	Near S-32	S-32	241.65	4,800	96

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM south of O-14. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development; as well as natural features such as Sawmill Run. Approximately 4.8 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 4 – Subsystem Alternative SMR-1b, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

S-18 to CSO 095J001 Region, CSO 097L001, CSO 139A001 to 139B002, and S-23 to S-29 Region portions of Alternative SMR-1b will be controlled via implementation of Sub-Surface Storage. Sub-Surface Storage facilities consist of a below grade storage unit, in combination with a screening unit, to temporarily store CSO waters. Stored flows from the facility are slowly reintroduced into the collection and conveyance system after the storm event concludes and the system equalizes. Sub-surface storage methods typically consist of closed concrete tanks, and are also equipped with a pump station and odor control measures.

CSO 034R001, CSO 138J001 to 138P001, CSO 139B003, DC 034N001, DC 035P001, DC 035S001, DC 062C001, DC 062D001, and DC 062K002 portions of Alternative SMR-1b will be controlled via implementation of Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall. At the time of design, lower cost small storage technologies could be considered for the overflows identified as "Low Flow/Remote (Sewer Separation)" on the alternative characteristics table.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

Alternative SMR-2a

Alternative SMR-2a is based upon Tunnel SMR-2a having an approximate length of 30,000 feet. *Attachment 5 – Subsystem Alternative SMR-2a Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and the approximate location of the tunnel. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows (outlier outfalls) in the Sawmill Run Subsystem will be controlled using the highest ranked CSO control technologies that were identified during the Outfall Specific Regional Alternatives Evaluation process. Detailed descriptions of these Outfall Specific and Regional Alternatives may be found in Appendices D and E.

Tunnel SMR-2a sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 172.90 MG to 22.38 MG for control levels of 0 to 6 overflow events, respectively. *Figure 3 – SMR-2a Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

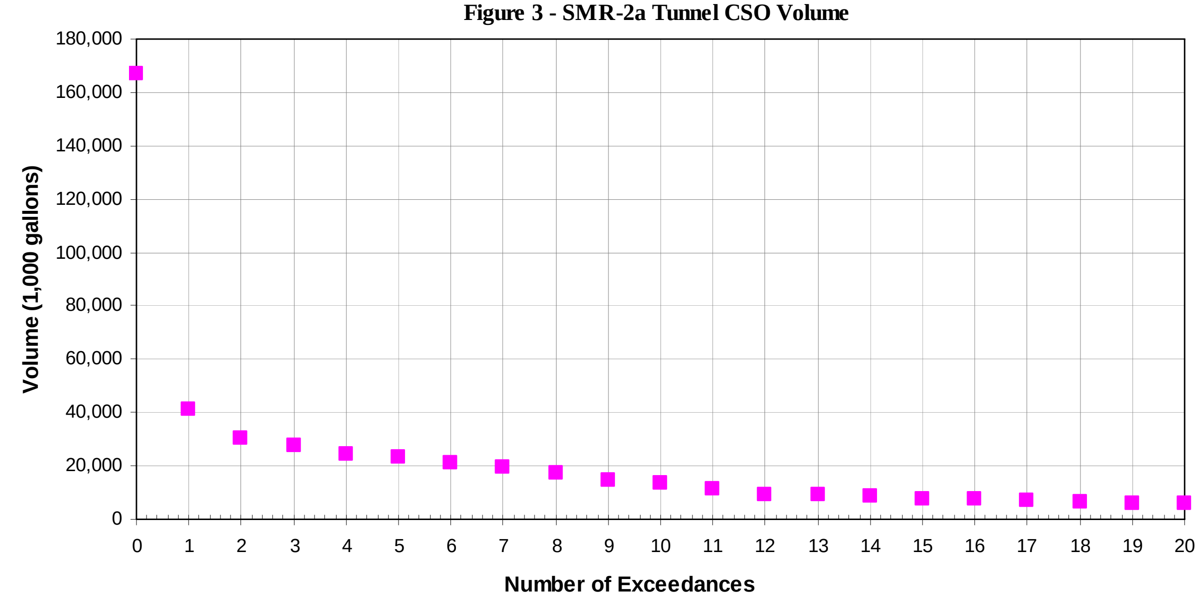


Figure 3 - SMR-2a Tunnel CSO Volume

Table 5 – Alternative SMR-2a Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation, sewershed characteristics, and the CSO control technology for each outfall and/or Region not controlled by the tunnel.

Table 5: Alternative SMR-2a Characteristics

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
O-14 to S-46 Region	O-14	8546	95	Tunnel SMR-2a
	O-14A			
	O-14B			
	S-46			
S-30	S-30			
S-31 to S-36 Region	CSO 015P001			
	S-31			
	S-32			
	S-33			
	S-34			
	S-35			
	S-36			
S-37 to S-42 Region	CSO 005R001 (S-37 and S-38)			
	S-39			
	ACSO 005F001 (S-40)			
	S-41			
	S-42			
CSO 019M001	CSO 019M001 (S-42A)			
S-18 to CSO 095J001 Region	CSO 095E001			
	CSO 095J001			
	S-18			
McDonoughs Run Region	CSO 097L001			
	CSO 139A001			
	CSO 139B001			
	CSO 139B002			
	CSO 139B003			
CSO 139F001	CSO 139F001			
S-23 to S-29 Region	S-23			
	S-24			
	S-28			

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
	S-29			
	CSO 060A001			
CSO 016A001 to 035J001	CSO 016A001	320	79	Sub-Surface Storage
	CSO 016A002			
	CSO 035A001			
	CSO 035E001			
	CSO 035J001			
CSO 036R001	CSO 036R001	428	82	Sub-Surface Storage
CSO 034R001	CSO 034R001	17	31	Low Flow/Remote (Sewer Separation)
CSO 138J001 to 138P001	CSO 138J001	21	42	Sewer Separation
	CSO 138P001			
CSO 138K001	CSO 138K001	1	0	No Activations
DC 034N001	CSO 015P001	8.6	13	Low Flow/Remote (Sewer Separation)
DC 035P001		4.1	10	Low Flow/Remote (Sewer Separation)
DC 035S001		3.2	15	Low Flow/Remote (Sewer Separation)
DC 035S002		29.9	NA	Direct Connection to Trunk Sewer
DC 062C001		5.6	4	Low Flow/Remote (Sewer Separation)
DC 062C002		1.7	0	No Activations
DC 062D001		15.3	10	Low Flow/Remote (Sewer Separation)
DC 062K001		2.4	0	No Activations
DC 062K002		4.3	14	Low Flow/Remote (Sewer Separation)

<u>Tunnel SMR-2a</u>

The Sawmill Run Tunnel SMR-2a would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-14 to the intersection of the ALCOSAN interceptor and the McDonoughs Run trunk sewer. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 24 MGD for 6 overflows.

Assuming a tunnel length of approximately 5.7 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level is 13.5 feet.

Other important components of Tunnel SMR-2a include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 6 – Tunnel SMR-2a Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 6: Tunnel SMR-2a Consolidation Sewer and Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
SMR-1	Near O-14	O-14, O-14A, O-14B	132.19	675	78
SMR-2	Near S-46	S-46	46.57	100	48
SMR-3	Near CSO 019M001	CSO 019M001	145.79	5,355	78
SMR-4	Near S-41	S-41	17.48	100	36
SMR-5	Near ACSO 005F001	ACSO 005F001	34.02	100	48
SMR-6	Near CSO 005R001	CSO 005R001 (S-37 and S-38), S-39	383.38	920	120
SMR-7	Near S-36	S-36, S-35, S-33	91.40	2,125	66
SMR-8	Near S-32	S-32	241.65	4,800	96

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
SMR-9	Near S-29	S-28, S-29	23.7	1,685	36
SMR-10	Near S-24	S-23, S-24, CSO 060A001	96.25	1,705	66
SMR-11	Near CSO 095J001	CSO 095E001, CSO 095J001, S-18	25.92	8,875	48
SMR-12	Near McDonoughs Run intersection with interceptor	CSO 139A001, CSO 139B001, CSO 139B002, CSO 139B003, CSO 097L001	206.89	7,095	96

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM south of O-14. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development; as well as natural features such as Sawmill Run. Approximately 5.2 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 6 – Subsystem Alternative SMR-2a, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>CSO 036R001 and CSO 016A001 to 035J001</u> portions of Alternative SMR-2a will be controlled via implementation of Sub-Surface Storage. Sub-Surface Storage facilities consist of a below grade storage unit, in combination with a screening unit, to temporarily store CSO waters. Stored flows from the facility are slowly reintroduced into the collection and conveyance system after the storm event concludes and the system equalizes. Sub-surface storage methods typically

consist of closed concrete tanks, and are also equipped with a pump station and odor control measures.

CSO 034R001, CSO 138J001 to 138P001 Region, DC 034N001, DC 035P001, DC 035S001, DC 062C001, DC 062D001, and DC 062K002 portion of Alternative SMR-2a will be controlled via implementation of Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall. At the time of design, lower cost small storage technologies could be considered for the overflows identified as “Low Flow/Remote (Sewer Separation)” on the alternative characteristics table.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

Alternative SMR-2b

Alternative SMR-2b is based upon Tunnel SMR-2b having an approximate length of 30,000 feet. *Attachment 7 – Subsystem Alternative SMR-2b Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and the approximate location of the tunnel. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows (outlier outfalls) in the Sawmill Run Subsystem will be controlled using the highest ranked CSO control technologies that were identified during the Outfall Specific and Regional Alternatives Evaluation process. Detailed descriptions of these Outfall Specific and Regional Alternatives may be found in Appendices D and E.

Tunnel SMR-2b sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 167.17 MG to 21.04 MG for control levels of 0 to 6 overflow events, respectively. *Figure 4 – SMR-2b Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

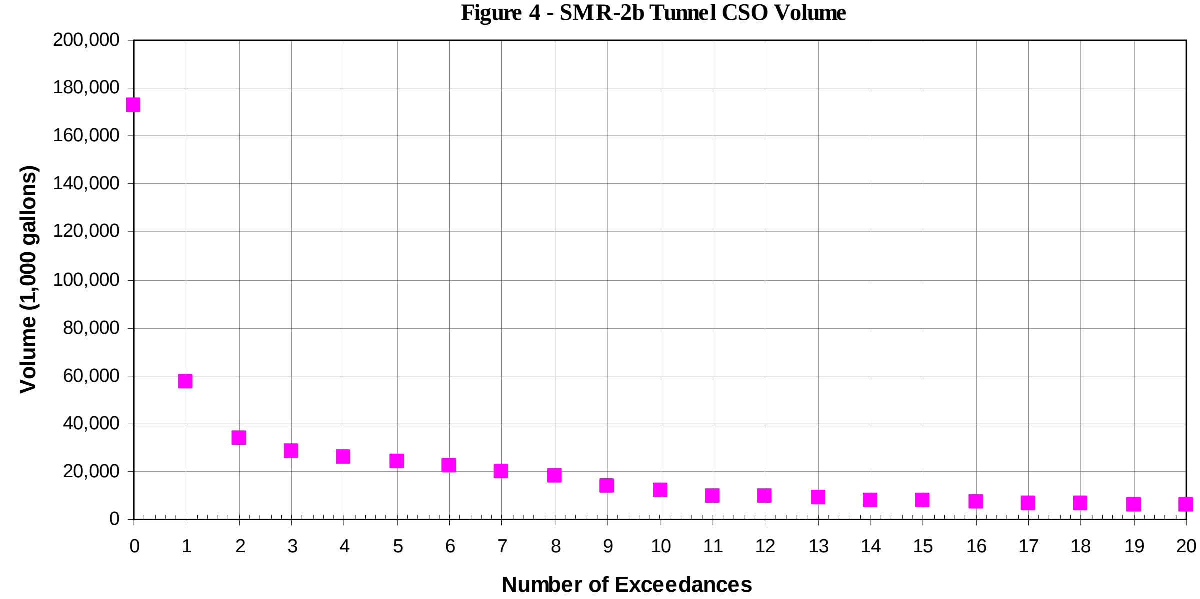


Figure 4 - SMR-2b Tunnel CSO Volume

Table 7 – Alternative SMR-2b Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation, sewershed characteristics, and the CSO control technology for each outfall and/or Region not controlled by the tunnel.

Table 7: Alternative SMR-2b Characteristics

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
O-14 to S-46 Region	O-14	9294	95	Tunnel SMR-2a
	O-14A			
	O-14B			
	S-46			
S-30	S-30			
S-31 to S-36 Region	CSO 015P001			
	S-31			
	S-32			

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
	S-33			
	S-34			
	S-35			
	S-36			
S-37 to S-42 Region	CSO 005R001 (S-37 and S-38)			
	S-39			
	ACSO 005F001 (S-40)			
	S-41			
	S-42			
CSO 019M001	CSO 019M001 (S-42A)			
S-18 to CSO 095J001 Region	CSO 095E001			
	CSO 095J001			
	S-18			
McDonoughs Run Region	CSO 097L001			
	CSO 139A001			
	CSO 139B001			
	CSO 139B002			
	CSO 139B003			
CSO 139F001	CSO 139F001			
S-23 to S-29 Region	S-23			
	S-24			
	S-28			
	S-29			
	CSO 060A001			
Little Sawmill Run Region	CSO 016A001			
	CSO 016A002			
	CSO 035A001			
	CSO 035E001			
	CSO 035J001			
	CSO 036R001			
CSO 034R001	CSO 034R001	17	31	Low Flow/Remote (Sewer Separation)
CSO 138J001 to 138P001	CSO 138J001	21	42	Sewer Separation
	CSO 138P001			
CSO 138K001	CSO 138K001	1	0	No Activations
DC 034N001	CSO 015P001	8.6	13	Low Flow/Remote (Sewer Separation)
DC 035P001		4.1	10	Low Flow/Remote (Sewer Separation)

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
DC 035S001		3.2	15	Low Flow/Remote (Sewer Separation)
DC 035S002		29.9	NA	Direct Connection to Trunk Sewer
DC 062C001		5.6	4	Low Flow/Remote (Sewer Separation)
DC 062C002		1.7	0	No Activations
DC 062D001		15.3	10	Low Flow/Remote (Sewer Separation)
DC 062K001		2.4	0	No Activations
DC 062K002		4.3	14	Low Flow/Remote (Sewer Separation)

Tunnel SMR-2b

The Sawmill Run Tunnel SMR-2b would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers O-14 to the intersection of the ALCOSAN interceptor and the McDonoughs Run trunk sewer. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 26 MGD for 4 overflows. Assuming a tunnel length of approximately 5.7 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level is 13.5 feet.

Other important components of Tunnel SMR-2b include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 8 – Tunnel SMR-2b Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of

0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 8: Tunnel SMR-2b Consolidation Sewer and Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
SMR-1	Near O-14	O-14, O-14A, O-14B	132.19	675	78
SMR-2	Near S-46	S-46	46.57	100	48
SMR-3	Near CSO 019M001	CSO 019M001	145.79	5,355	78
SMR-4	Near S-41	S-41	17.48	100	36
SMR-5	Near ACSO 005F001	ACSO 005F001	199.94	14,960	90
SMR-6	Near CSO 005R001	CSO 005R001 (S-37 and S-38), S-39	383.38	920	120
SMR-7	Near S-36	S-36, S-35, S-33	91.40	2,125	66
SMR-8	Near S-32	S-32	241.65	4,800	96
SMR-9	Near S-29	S-28, S-29	23.7	1,685	36
SMR-10	Near S-24	S-23, S-24, CSO 060A001	96.25	1,705	66
SMR-11	Near CSO 095J001	CSO 095E001, CSO 095J001, S-18	25.92	8,875	48
SMR-12	Near McDonoughs Run intersection with interceptor	CSO 139A001, CSO 139B001, CSO 139B002, CSO 139B003, CSO 097L001	206.89	7,095	96

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM south of O-14. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development;

as well as natural features such as Sawmill Run. Approximately 5.5 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 8 – Subsystem Alternative SMR-2b, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

CSO 034R001, CSO 138J001 to 138P001, DC 034N001, DC 035P001, DC 035S001, DC 062C001, DC 062D001, and DC 062K002 portions of Alternative SMR-2b will be controlled via implementation of Sewer Separation. The separation of sanitary and storm sewers such that the drainage area is served by independent sanitary and stormwater sewer systems would reduce the hydraulic loading to the outfall. By definition, the complete separation of sewers would result in the elimination of all CSOs at the outfall. At the time of design, lower cost small storage technologies could be considered for the overflows identified as “Low Flow/Remote (Sewer Separation)” on the alternative characteristics table.

Details for the CSO volume and peak rate flows, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

Alternative Evaluation Results

Table 9 – Sawmill Run Subsystem Alternative Costs, illustrates the planning level capital, O&M and present worth costs associated with alternatives SMR-1a, SMR-1b, SMR-2a, and SMR-2b, when sized for 4 untreated overflows per year.

Table 9: Sawmill Run Subsystem Alternative Costs

Subsystem	Capital Cost (MM$)	Annual O&M Cost (MM$)	PW Cost (MM$)
SMR-1a	249.3	2.1	272.1
SMR-1b	253.3	1.9	274.0
SMR-2a	246.2	1.6	265.1
SMR-2b	251.8	1.5	269.0

For the purpose of this Feasibility Study, the above alternatives were further evaluated based on a combination of their economic, environmental, implementation, and operational impacts over a range of CSO control levels corresponding to 4 untreated overflows per year.

Attachment 9 – Sawmill Run Subsystem Alternatives Scoring Sheet illustrates the composite scoring of economic, environmental, implementation, an operational evaluation factors for a control level of 4 overflows per year. Complete details of the economic evaluation and the composite scoring of economic, environmental, implementation and operational evaluation factors can be found in Appendix F.

Recommendations

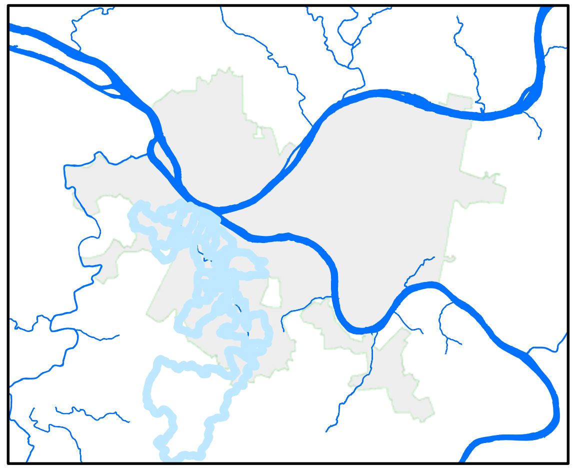
It is recommended that the following alternative be carried forward as part of the overall System-Wide alternative

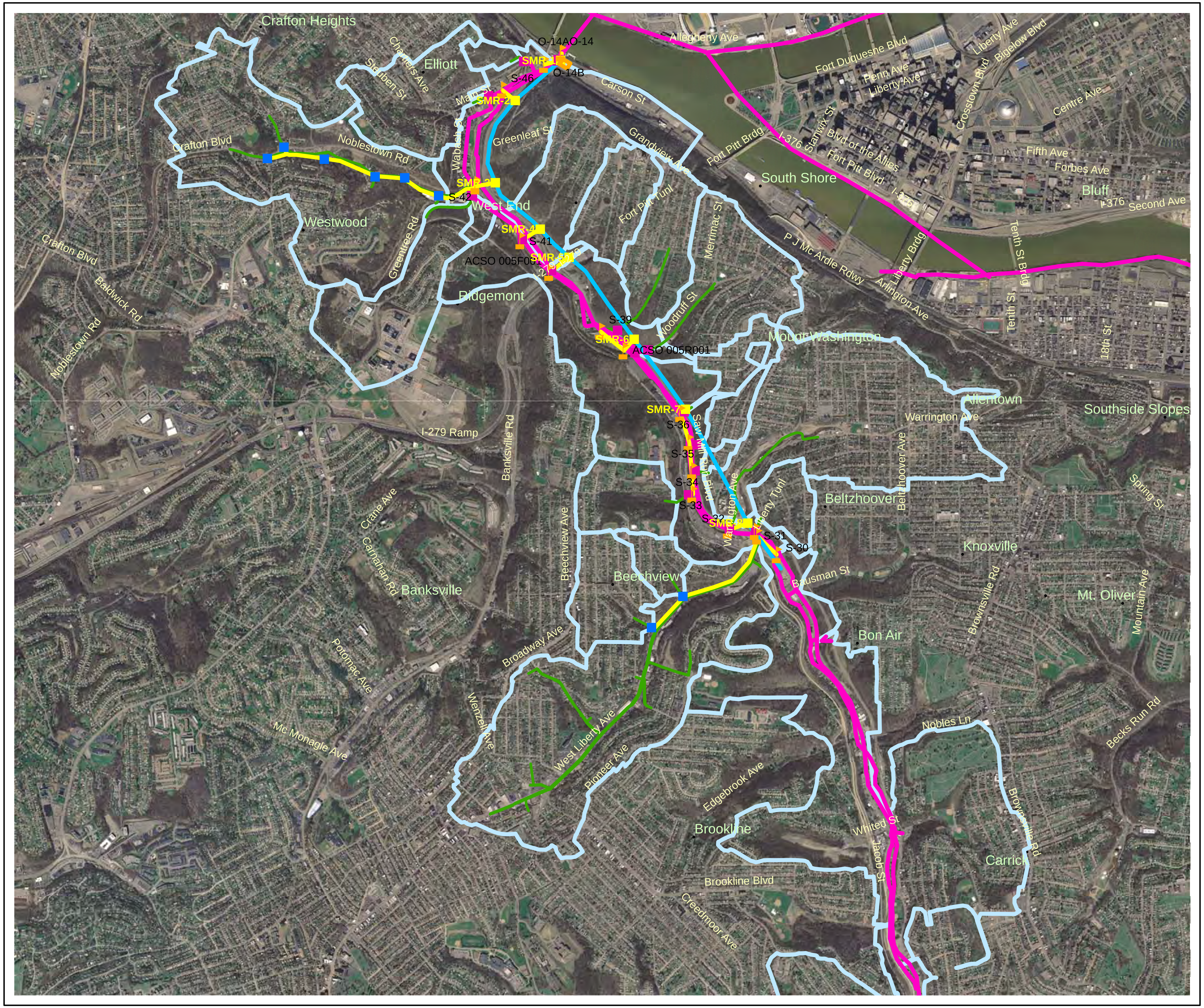
- SMR-2b: This alternative resulted in the highest score for control level of 4 events per year.

Significant Issues

Some issues exist with the siting of a tunnel. It appears that there is some space for the facilities associated with the tunnel, however, there is significant infrastructure at the confluence of Sawmill Run and the Ohio River. Detailed geotechnical studies would have to be completed to determine the suitability of the underlying subsurface conditions for tunnel construction. In addition, construction of drop shafts and the consolidation sewers will be a significant endeavor considering the congested infrastructure and natural features that exist in the area where the sewers would be constructed. In addition to the geotechnical studies, permitting, and land acquisition would determine the final location of these facilities if this alternative is selected for implementation. Any potential issues associated with the outlier outfalls are presented in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

ATTACHMENT C - APPENDIX F-4 SMR





Legend

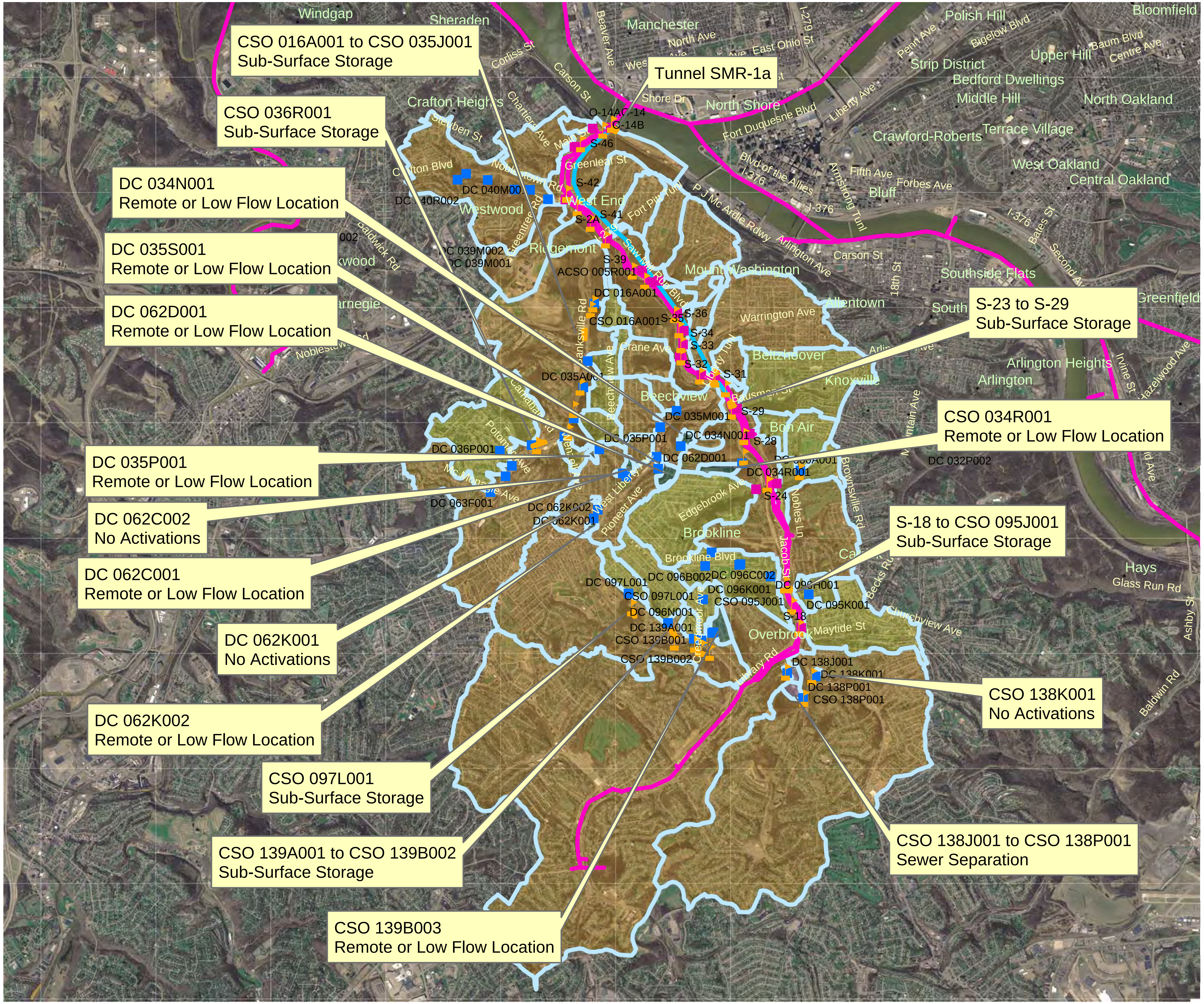
- Faciliy Boundary
- Tunnel SMR-1a
- Consolidation Pipe
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

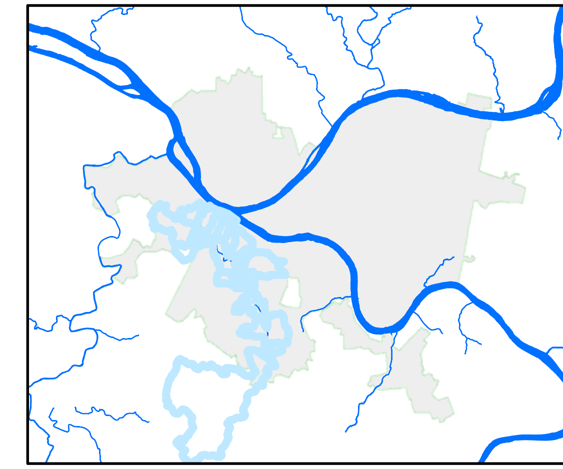
3,000 0 3,000
Feet

Attachment 1 Subsystem Alternative SMR-1a Tunnel Portion

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

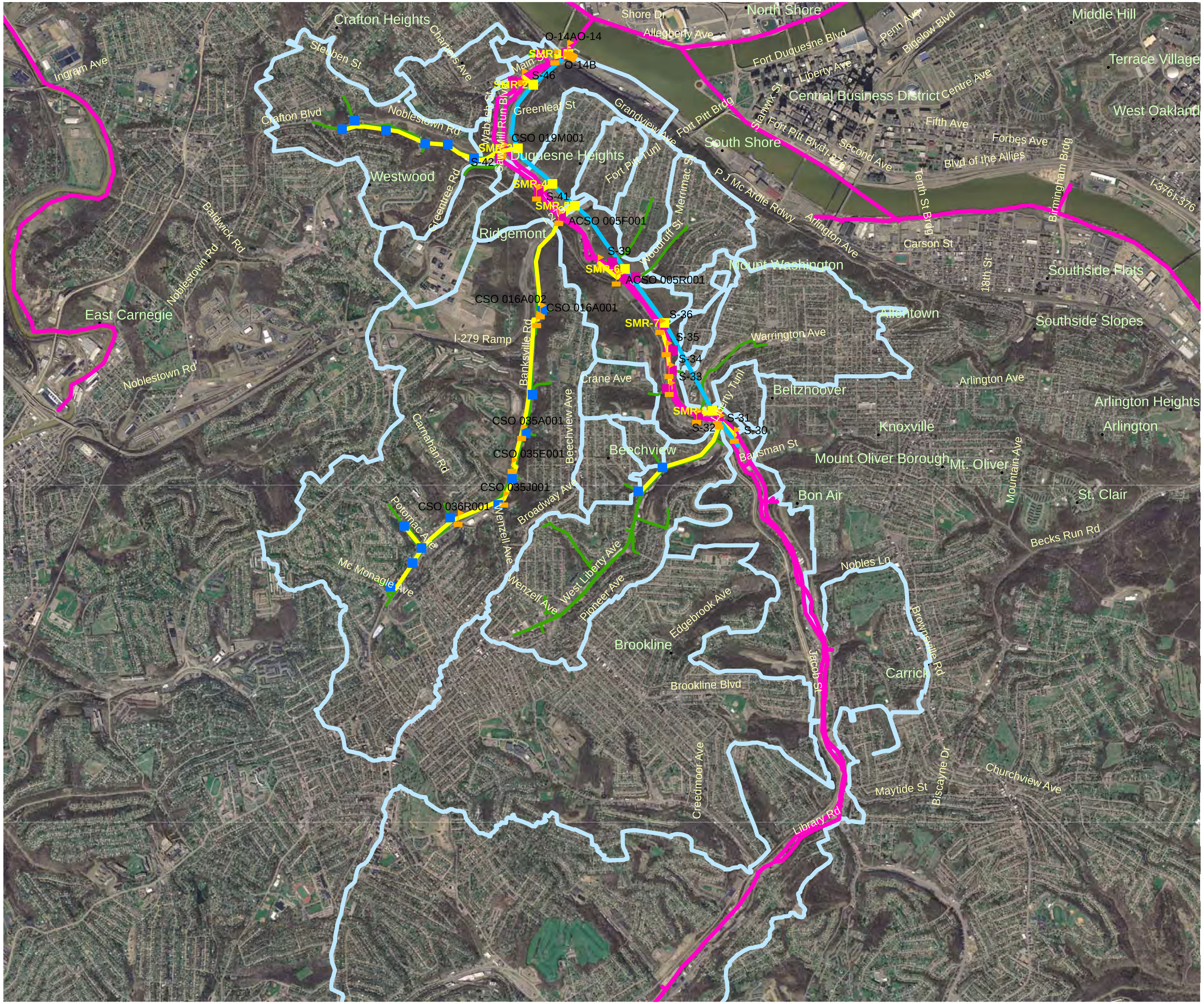


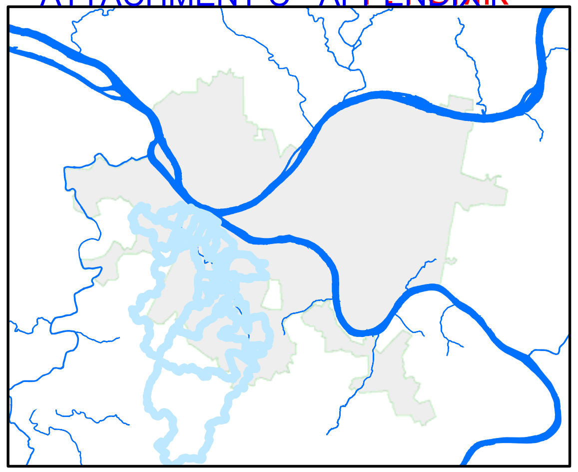


Attachment 2
Subsystem Alternative SMR-1a

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

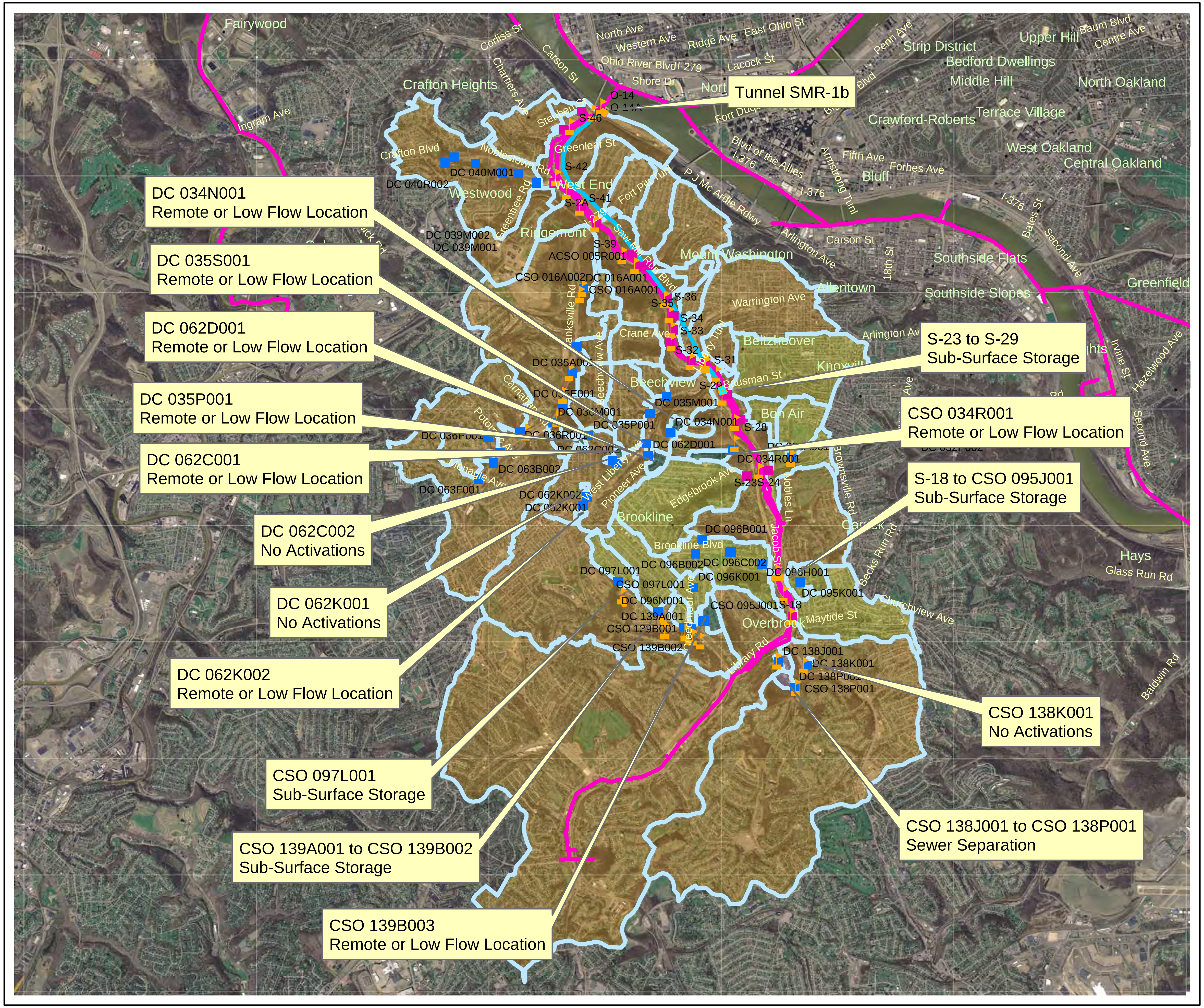
- Facility Boundary
- Tunnel SMR-1b
- Consolidation Pipe
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

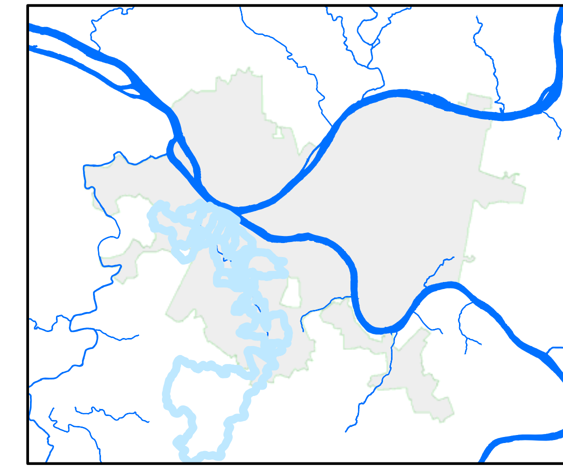
3,000 0 3,000
Feet

Attachment 3 Subsystem Alternative SMR-1b Tunnel Portion

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Sewer Separation
- No Activations
- Sub-surface Storage
- Remote or Low Flow Location
- Tunnel SMR-1b
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Combined Sewer Outfall

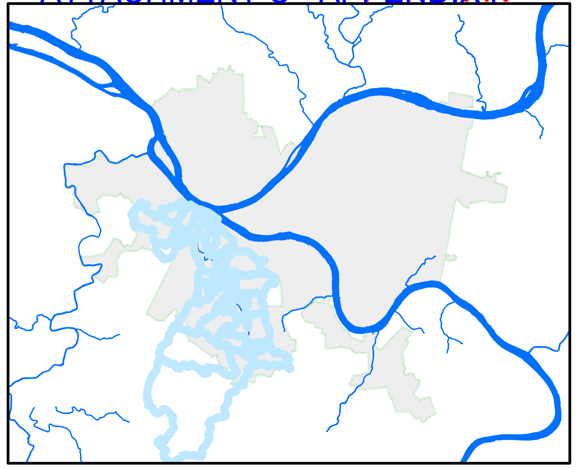
3,000 0 3,000
Feet

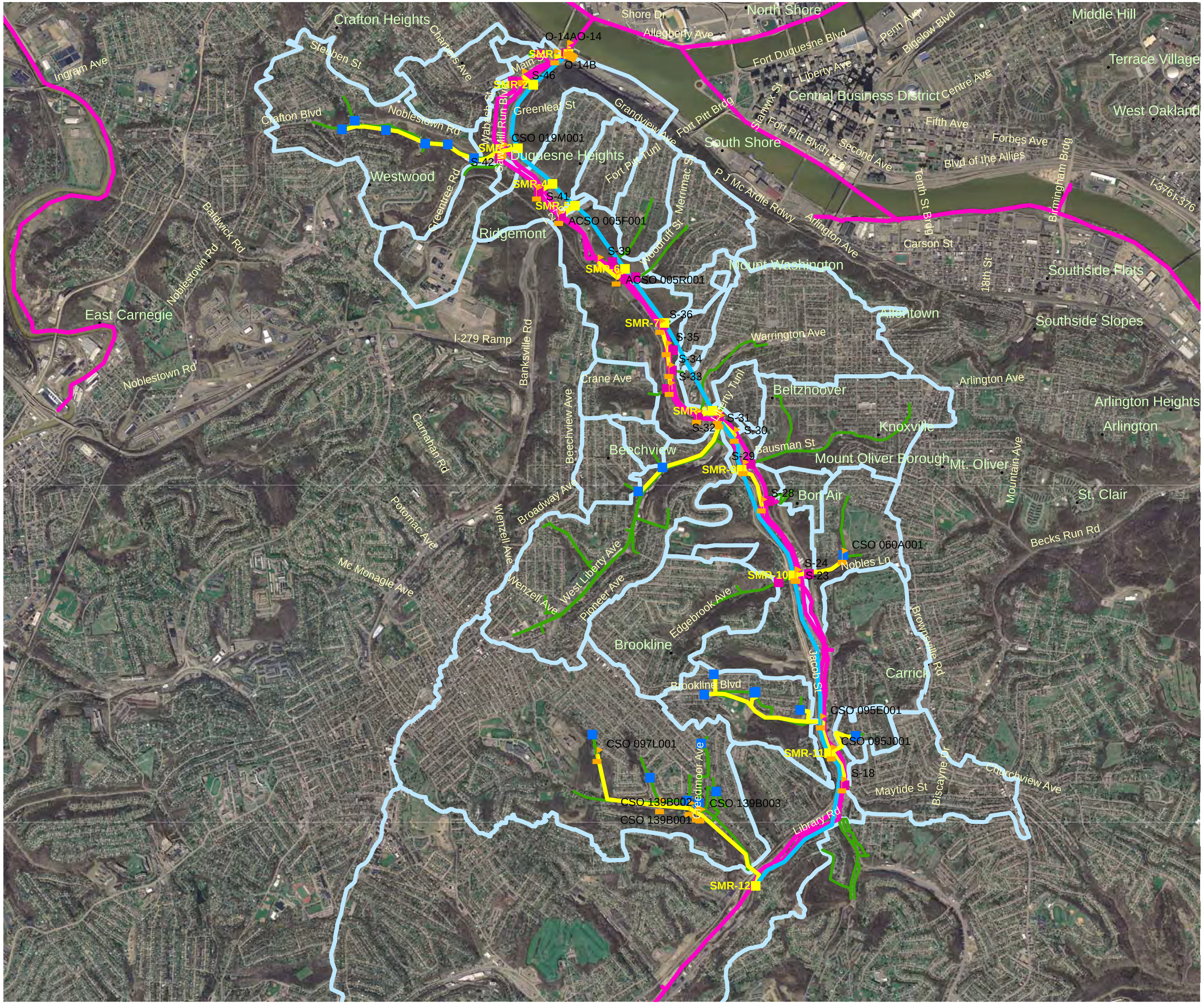
Attachment 4
Subsystem
Alternative SMR-1b

CSO Controls Alternatives

THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

ATTACHMENT C - APPENDIX F-1 SMR





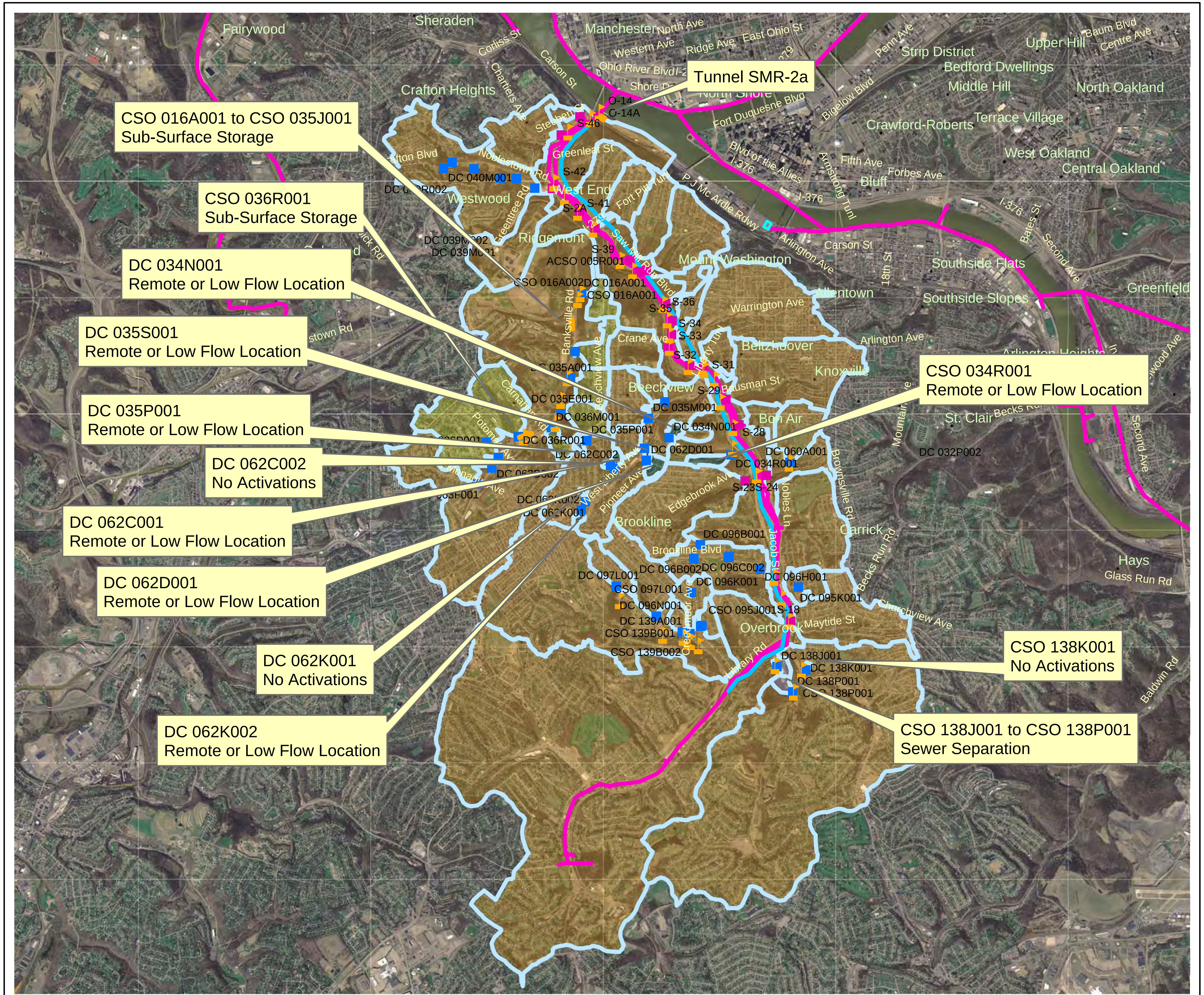
Legend

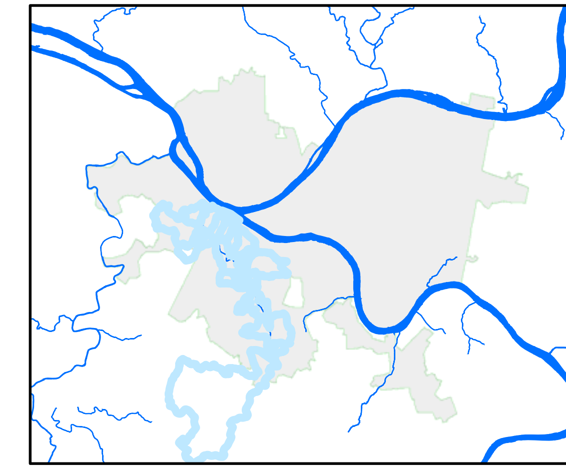
- Sewershed Boundary
- Facility Boundary
- Tunnel SMR-2a
- Consolidation Pipe
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

3,000 0 3,000 Feet

Attachment 5 Subsystem Alternative SMR-2a Tunnel Portion

CSO Controls Alternatives





Legend

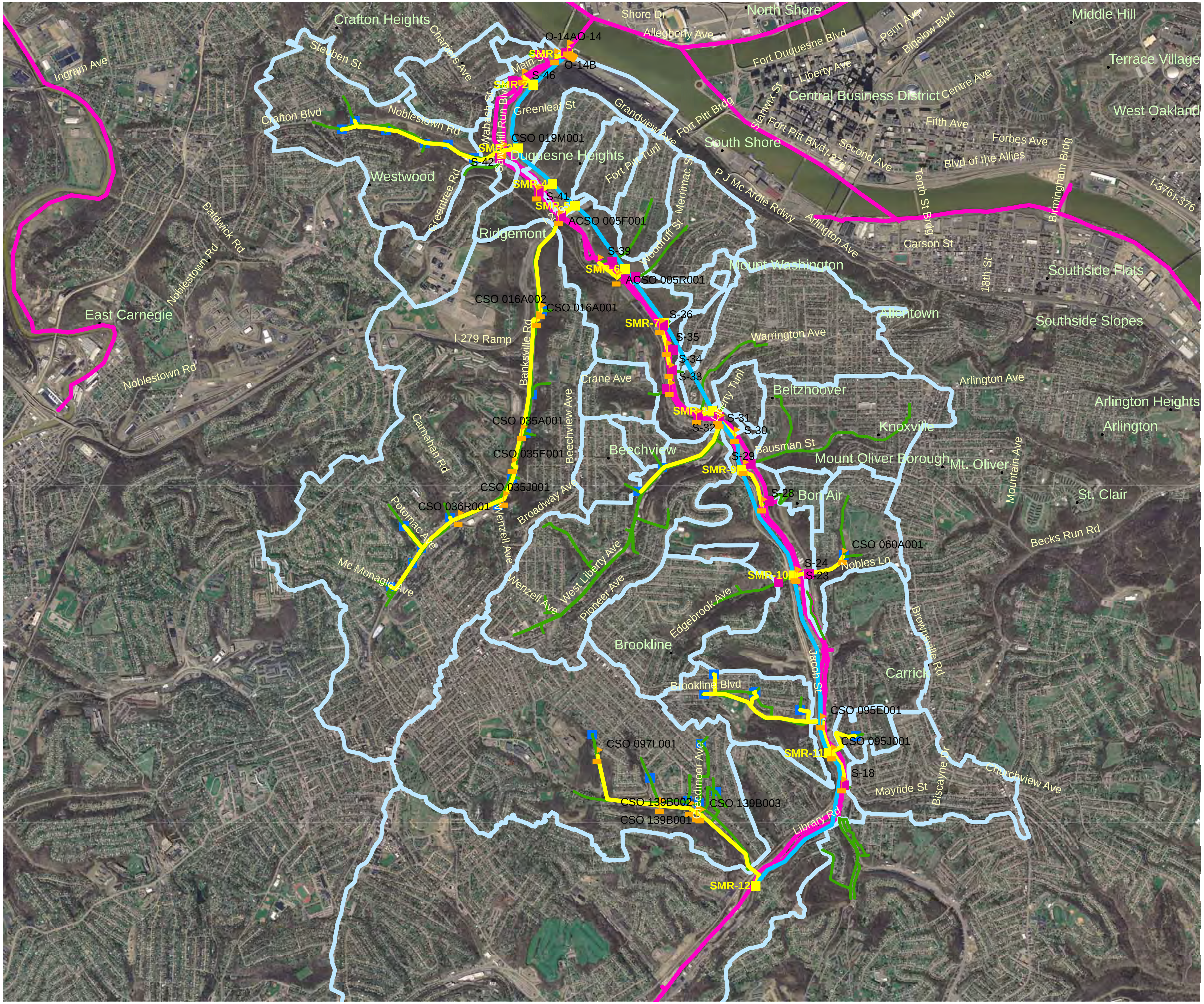
- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Sub-Surface Storage
- Sewer Separation
- Remote or Low Flow Location
- No Activations
- Tunnel SMR-2a
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Combined Sewer Outfall

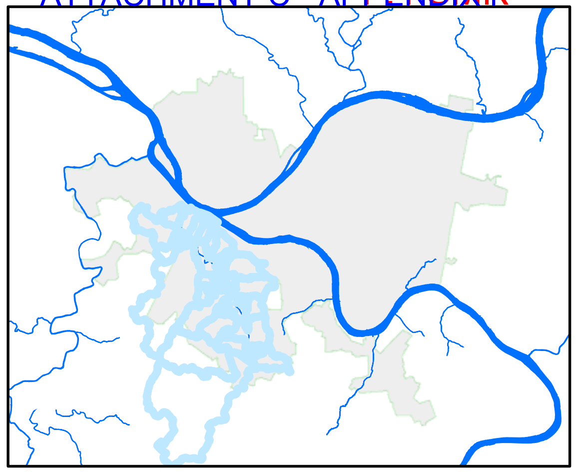
3,000 0 3,000
Feet

Attachment 6 Subsystem Alternative SMR-2a

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

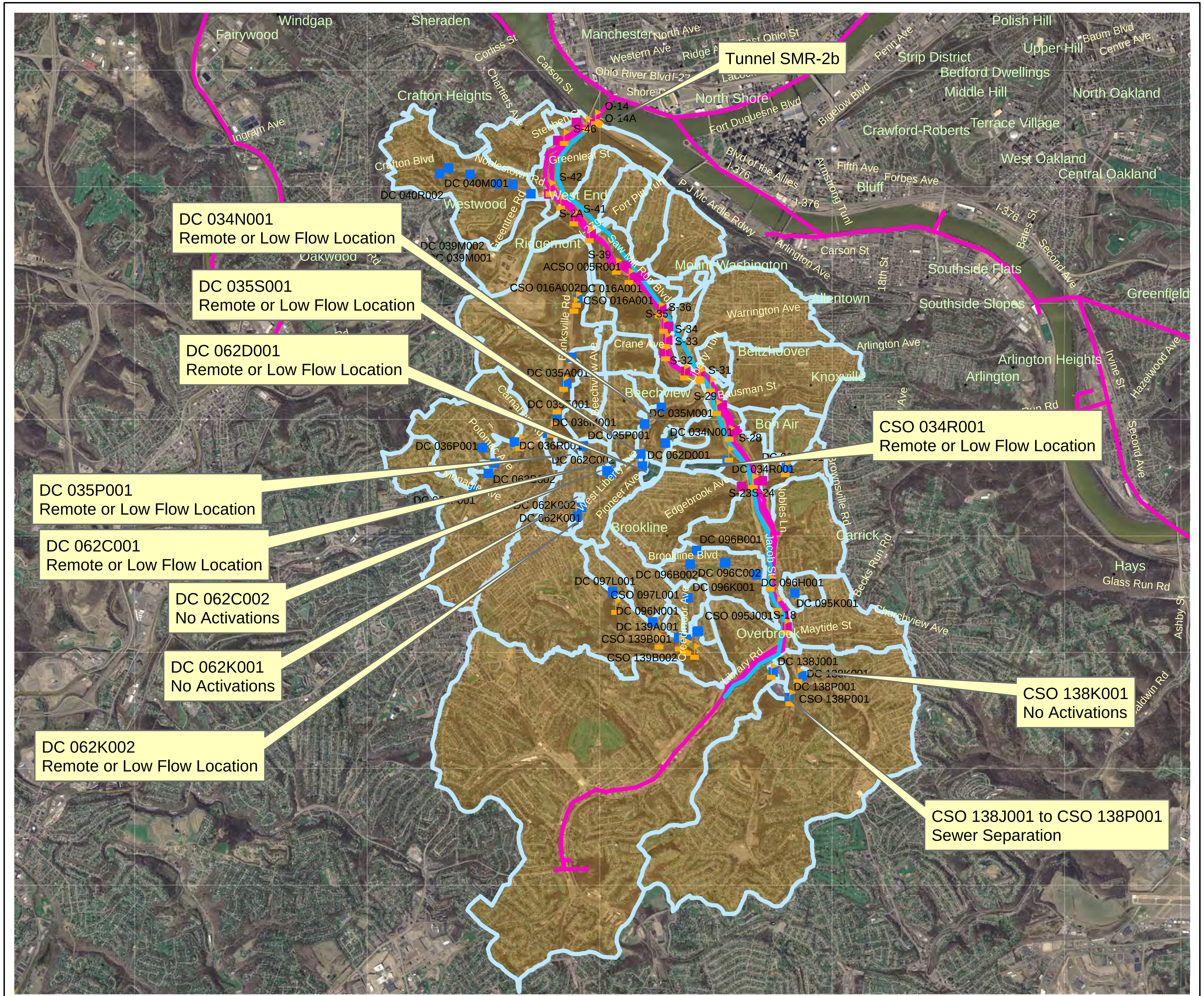
- Sewershed Boundary
- Facility Boundary
- Tunnel SMR-2b
- Consolidation Pipe
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

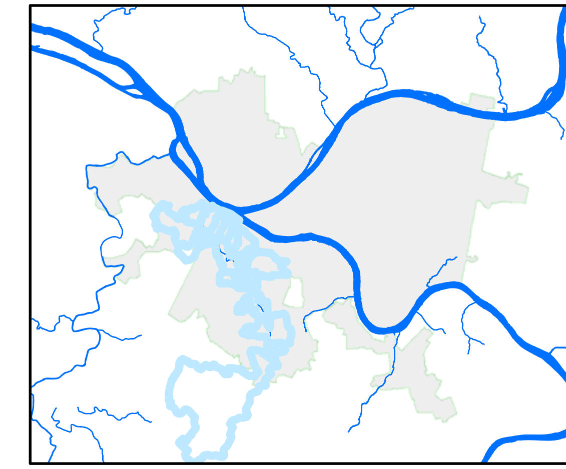
3,000 0 3,000 Feet

Attachment 7 Subsystem Alternative SMR-2b Tunnel Portion

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Sewer Separation
- Remote or Low Flow Location
- No Activations
- Tunnel SMR-2b
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Combined Sewer Outfall

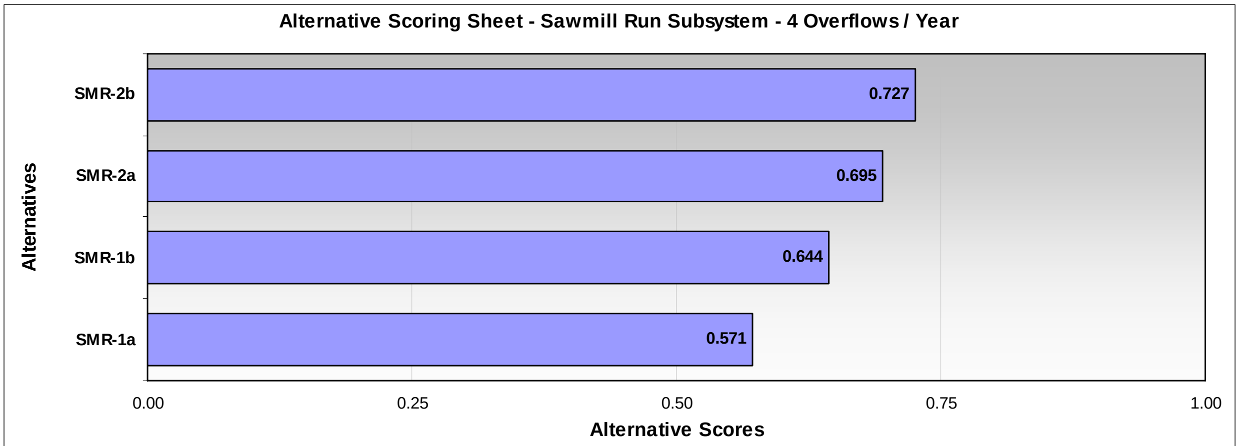
3,000 0 3,000 Feet

Attachment 8
Subsystem
Alternative SMR-2b

CSO Controls Alternatives

PWSA THE PITTSBURGH WATER & SEWER AUTHORITY Quality Water Quality Service

Attachment 9 – Sawmill Run Subsystem Alternatives Scoring Sheet



Alternative Menu

NOTE: All PW Costs are in million $; all capital costs are in $.

CC-1				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 17,666,000
TUNNEL STORAGE (C-2 through C-13A)				
RIVER CROSSING #1 - Microtunnel				
N/A				
RIVER CROSSING #2 - Microtunnel				
N/A				
RIVER CROSSING #3 - Microtunnel				
N/A				
RIVER CROSSING #4 - Microtunnel				
N/A				
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
C-25				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	4.25 MG	Surface Storage	$ 15.4	$ 11,751,000
C-26A to C-29				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	11.64 MGD	Screening & Disinifection	$ 8.5	$ 6,563,000
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)

Alternative Menu

Size / Cost (4/yr):				
Bells Run Region				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):	NA	Sub-Surface Storage	$ 29.9	$ 28,298,568

Alternative Menu

CC-2				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 46,289,000
TUNNEL STORAGE (C-2 through C-29)				
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)

Alternative Menu

Size / Cost (4/yr):				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				

Objective Scoring

Alternative:	CC-1	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	5
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	CC-1	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	3
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	CC-1	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	3
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	CC-1	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	2
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	CC-1	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	3
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	CC-1	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	3
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	CC-1	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	3
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	CC-1	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Difficult Req’s	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	1
3	Moderate Req’s	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req’s	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	CC-1	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	3
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	CC-1	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	CC-1	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	3
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	CC-1	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	2
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	CC-1	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	2
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team

Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Objective Scoring

Alternative:	CC-2	Objective Scoring: Present Worth	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	PW Cost is more than 40% higher than the cost of the least expensive control alternative.	4
2	High Cost	PW Cost is between 30% and 40% more than the cost of the least expensive control alternative.	
3	Moderate Cost	PW Cost is between 20% and 30% more than the cost of the least expensive control alternative.	
4	Low Cost	PW Cost is between 10% and 20% more than the cost of the least expensive control alternative.	
5	Very Low Cost	PW Cost is within 10% of the cost of the least expensive control alternative.	

Alternative:	CC-2	Objective Scoring: Pollution Reduction	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Minimal Treatment	Provides minimal pollution reduction, with little or no reduction of TSS, bacteria etc. Applicable for floatables control and large screenings (clogs, debris etc.)	4
2	Less than Primary Treatment	Some TSS removal or varying effectiveness of sediment removal. Less than sufficient handling of bacteria and/or floatables. Example, screening and disinfection facilities. Net result of sewer separation due to large increases of storm water pollutant loads compared to reduction of CSO.	
3	Primary Treatment	Meets EPA minimum treatment guidelines for CSO. Includes primary clarification, floatables / debris control and disinfection, if required. For example, CSOTF, vortex separation or increased primary tankage at WWTP	
4	Primary to Secondary Treatment	Ensures at least minimum treatment per EPA guidelines with up to full secondary treatment at times. For example, deep storage tunnels and storage tanks capture, store and convey flow to WWTP where it receives at least primary and up to secondary treatment, per available capacity. Also, high rate end-of-pipe treatment can show greater than primary treatment levels.	
5	Secondary Treatment	Provides full secondary treatment for CSO at all times. For example, regulator modifications that send all flows to the WWTP.	

Alternative:	CC-2	Objective Scoring: Impact on Habitat, Stream, River etc.	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Negative Impact	Extreme reduction of natural habitat and/or stream flooding / erosion. Example: constructing large treatment facility with centralized effluent in natural resource habitat with streams, wildlife, etc.	3
2	Mod Negative Impact	Reduces habitat acreage and/or increases stream bank erosion. Example: moderate sized storage / treatment facility (CSOTF and HREOP) in natural setting or sewer separation resulting in increased storm water flow and bank erosion. Also, alternatives that could discharge harmful chemical by-products, i.e. THMs	
3	No Impact	Alternative does not change habitat characteristics or increase erosion. Volume / frequency remain the same. For example, end-of-pipe treatment facilities such as vortex separators and screening and disinfection facilities. Include facilities without disinfection by-products located away from stream and natural habitats.	
4	Mod Positive Impact	Alternative is not located in habitat and significantly reduces volume / frequency of wet weather flow in stream. For example, storage tanks or deep tunnels located outside of habitat.	
5	Positive Impact	Essentially eliminates flows and is not located in habitat. For example, storage / conveyance system that eliminates CSO. Also, alternative that increases habitat, such as wetlands constructed for treatment.	

Objective Scoring

Alternative:	CC-2	Objective Scoring: Constructability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Community Disruption	Construction activities producing extreme, sustained, widespread disruption to community. Large scale surface impacts that interrupt traffic / access and cause extreme levels of noise, odor, vibration or other inconveniences. Example: complete open-cut sewer separation in large, heavily populated area. Site specific.	3
2	Significant Community Disruption	Construction activities producing significant intermittent or short duration disruptions that result in interruption to traffic / access and cause significant levels of noise, odor, vibration or other inconveniences. For example, storage tank installation that requires significant excavation in heavily populated area. Site specific.	
3	Moderate Community Disruption	Construction activities producing moderate levels of noise, odor, vibration or other inconveniences over sustained periods of time and over large areas. For example, several drop shafts with mining pipe and material delivery in heavily populated area. Site specific.	
4	Minimal Community Disruption	Construction activities producing minimal levels of noise, odor, vibration or other inconveniences over short periods of time in limited areas. For example, regulator modifications involving short periods of excavation. Site specific.	
5	No Community Disruption	Alternative construction produces no contributions to noise, odor, vibration or other inconveniences. For example, adjustment to fixed weir or automatic gate that does not require excavation.	

Alternative:	CC-2	Objective Scoring: Permanent Land Requirement	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Extreme Land Requirement	Alternative has extreme permanent land requirement. For example, construction of a surface storage tank would require a large amount of land.	4
2	Large Land Requirement	Alternative has large permanent land requirement. For example, construction of a sub-surface storage tank could require a lesser amount of land if the surface of the tank could be used for parking or some other activity.	
3	Moderate Land Requirement	Moderate permanent land requirement. Example: construction of tunnel storage requires access shafts and other appurtenances that in total, would use less land than other storage methods.	
4	Small Land Requirement	Alternative has small permanent land requirement. For example, construction of screening and disinfection facilities only. Typically includes sewer separation due to construction within existing easements.	
5	No Land Requirement	Alternative has no permanent land requirement. For example, adjustment to fixed weir or automatic gate that does not require construction of additional facilities.	

Alternative:	CC-2	Objective Scoring: Public Acceptance	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Strong Public Opposition	Alternative would likely result in major opposition. For example, open storage tanks in residential areas. Post construction consideration. Assume some type of CSO control to be constructed.	3
3	No Public Reaction	Alternative has no significant history of opposition. For example, collection system optimization and most treatment alternatives. Post construction consideration. Assume some type of CSO control to be constructed.	
5	Strong Public Support	Alternative would be embraced by the public over others. May include site enhancement such as a park over a sub-surface tank. Post construction consideration. Assume some type of CSO control to be constructed.	

Objective Scoring

Alternative:	CC-2	Objective Scoring: Institutional Constraints	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Not in PWSA Jurisdiction	Not located within PWSA owned sewer system. Example: source controls and collection system controls in outlying municipalities.	1
3	Shared Jurisdiction	PWSA relief sewer that also requires local relief sewers or ALCOSAN WWTP expansion.	
5	PWSA Jurisdiction	Storage, treatment and collection systems within the PWSA owned sewer system; real-time controls, regulator modifications.	

Alternative:	CC-2	Objective Scoring: Siting Restrictions	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Difficult Req's	Requires extensive approval process involving permitting / acceptance effort. Example: emerging technology (i.e. ballasted flocculation) with little installation history, may require pilot facilities and studies. Also, an alternative which requires a series of wetland, architectural and community permits. Example: traffic permitting for a large open-cut relief sewer in Oakland.	3
3	Moderate Req's	Normal review & approval process requiring minimal permits. Example: a tunnel located w/in existing right-of-ways, requiring plan review/ approval from <three authorities.	
5	No Req's	No permits required. Example: expanding existing PWSA facilities, such as raising weirs.	

Alternative:	CC-2	Objective Scoring: Operating Complexity	Actual Scores
Baseline Score	Metric	Example / Explanation	4 OF
1	Extremely Complex; Req's Significant Trng and/or Staff	Example: High rate end-of-pipe treatment alternatives.	4
2	Difficult to Operate; Req's Specific Trng	Example: elaborate real-time control alternatives. Vortex separators.	
3	Moderately Complex; Req's General Trng	Example: CSO treatment facility or screening and disinfection facilities.	
4	Simple to Operate; Req's Limited Trng	Example: Storage / conveyance tunnels with pump station.	
5	Little or No O&M Required	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	CC-2	Objective Scoring: Flexibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Cannot be Exp. for Add'l CSO Control	Example: Storage / treatment facility located on site with no available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	3
3	May be Exp. on Ltd Basis, w/ Some Difficulty	Example: Storage / treatment facility located on site with available adjacent land for expansion. Site restrictions and ease of facility expansion to be considered.	
5	Could be Easily Expanded	Example: Real-time control located in a conveyance system with available capacity. Site restrictions and ease of facility expansion to be considered.	

Alternative:	CC-2	Objective Scoring: Reliability	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	History of Significant Problems / Ltd Track Record	Example: High rate end-of-pipe alternatives.	5
3	Mod Reliable, Req's Routine Maint. & Repair	Example: CSO treatment facilities. Most other treatment units.	
5	Minimum Maint with Proven Track Record	Example: Storage tanks tunnels. Also includes separation and regulator optimization.	

Alternative:	CC-2	Objective Scoring: Compatibility	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	No PWSA Experience	Example: High rate end-of-pipe alternatives.	3
2	Very little PWSA Exp	Example: End of pipe CSO Treatment Facility such as detention and treatment, swirl separators and screening and disinfection units.	
3	Limited PWSA Experience	Example: Sub-surface storage tanks and tunnels.	
4	Moderate PWSA Exp	Example: Above grade storage facilities.	
5	Extensive PWSA Exp	Example: Sewer separation and regulator optimization.	

Objective Scoring

Alternative:	CC-2	Objective Scoring: Annual O&M	Actual Scores
Baseline Score	**Metric**	**Example / Explanation**	**4 OF**
1	Very High Cost	Annual O&M Cost is more than 20% higher than the average Annual O&M Cost for all Alternatives.	4
2	High Cost	Annual O&M Cost is between 10% and 20% higher than the average Annual O&M Cost for all Alternatives.	
3	Moderate Cost	Annual O&M Cost is within +/-10% of the average Annual O&M Cost for all Alternatives.	
4	Low Cost	Annual O&M Cost is between 10% and 20% lower than the average Annual O&M Cost for all Alternatives.	
5	Very Low Cost	Annual O&M Cost is more than 20% lower than the average Annual O&M Cost for all Alternatives.	

Yellow Box = Objective scores determined by PWSA / Consultant Team
Result of Input: Used in calculation of Subjective and Total Scores in Sheet 2.

Total Score

Alternative:	CC-1		Control Level:	0 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.112	0.056
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	1	0.00	0.040	0.000
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	5	1.00	0.128	0.128
			Sum Total:	**0.629**

Alternative:	CC-1		Control Level:	1 Overflow / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	1	0.00	0.040	0.000
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	5	1.00	0.128	0.128
			Sum Total:	**0.627**

Alternative:	CC-1		Control Level:	2 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	1	0.00	0.040	0.000
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	5	1.00	0.128	0.128
			Sum Total:	**0.627**

Alternative:	CC-1		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score

Total Score

Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	1	0.00	0.040	0.000
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	2	0.25	0.128	0.032
			Sum Total:	**0.531**

Alternative:	**CC-1**		**Control Level:**	**6 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	3	0.90	0.112	0.101
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	2	0.15	0.062	0.009
Permanent Land Requirement	3	0.50	0.042	0.021
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	3	0.50	0.033	0.017
Siting Restrictions	1	0.00	0.040	0.000
Operating Complexity	3	0.45	0.078	0.035
Flexibility	3	0.50	0.053	0.027
Reliability	3	0.50	0.102	0.051
Compatibility	2	0.25	0.042	0.011
Annual O&M	5	1.00	0.128	0.128
			Sum Total:	**0.627**

Total Score

Alternative:	CC-2		Control Level:	0 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	1	0.00	0.147	0.000
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	1	0.00	0.128	0.000
			Sum Total:	**0.484**

Alternative:	CC-2		Control Level:	1 Overflow / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	4	0.75	0.147	0.110
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	1	0.00	0.128	0.000
			Sum Total:	**0.594**

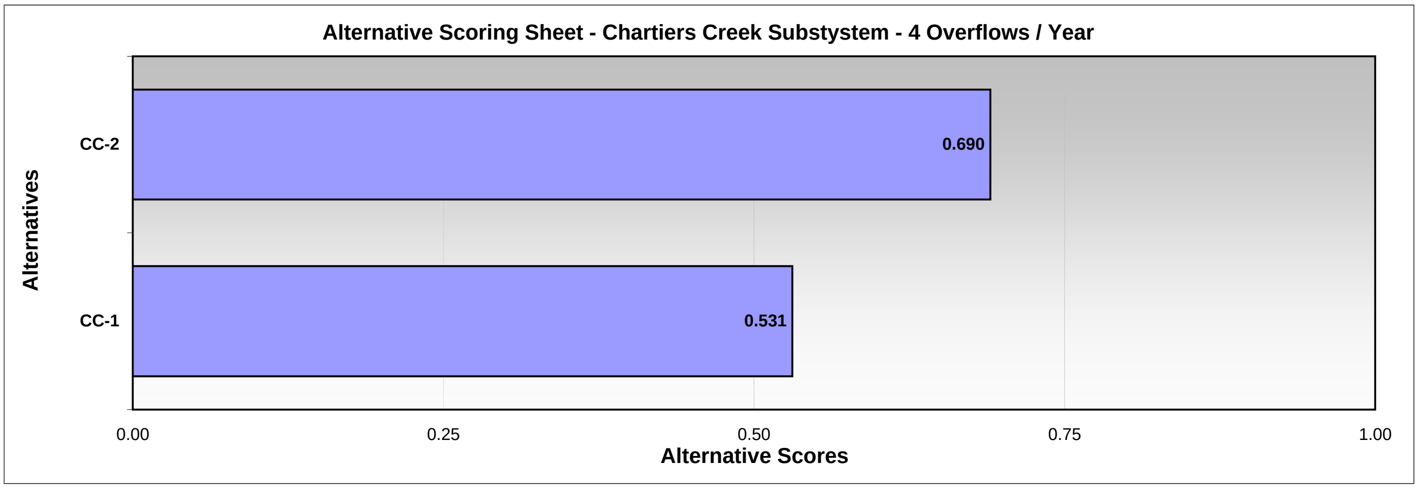
Alternative:	CC-2		Control Level:	2 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	5	1.00	0.147	0.147
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	1	0.00	0.128	0.000
			Sum Total:	**0.631**

Alternative:	CC-2		Control Level:	4 Overflows / Year
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score

Total Score

Present Worth Cost	4	0.75	0.147	0.110
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	4	0.75	0.128	0.096
			Sum Total:	**0.690**

Alternative:	**CC-2**		**Control Level:**	**6 Overflows / Year**
	Objective Score	Subjective Score	Weighting Factor	Weighted Subj. Score
Present Worth Cost	3	0.50	0.147	0.074
Pollution Reduction	4	0.92	0.112	0.103
Impact on Habitat, River, Stream etc.	3	0.50	0.108	0.054
Constructability	3	0.50	0.062	0.031
Permanent Land Requirement	4	0.85	0.042	0.036
Public Acceptance	3	0.50	0.053	0.027
Institutional Constraints	1	0.00	0.033	0.000
Siting Restrictions	3	0.50	0.040	0.020
Operating Complexity	4	0.82	0.078	0.064
Flexibility	3	0.50	0.053	0.027
Reliability	5	1.00	0.102	0.102
Compatibility	3	0.50	0.042	0.021
Annual O&M	1	0.00	0.128	0.000
			Sum Total:	**0.557**


Alternative Scoring Sheet - Chartiers Creek Substystem - 4 Overflows / Year
Alternatives
CC-2
0.690
CC-1
0.531
0.00
0.25
0.50
0.75
1.00
Alternative Scores

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	86	
Peak Volume	957,508	CF
	7.16	MG
Total Volume	18,424,172	CF
	137.81	MG
Peak Rate	260.42	CFS
	168.30	MGD

CONSOLIDATION SEWERS - Total		
86 Overflows / Year		
SUBTOTAL CAPITAL COST	**$**	**17,666,000**

Capital Costs

TUNNEL STORAGE (C-2 through C-13A)			
86 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	7.16	958,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	8.95	1,198,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	11.5		Input by Engineer
Tunnel Volume / Ft length (CF)	103.82		Ref: Tunnel diameter
Tunnel Length (Ft)	11,540		= Req'd Fac Vol / Vol per Ft Length; Target length is 11,941 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	6	3	
Additional Drop Shafts Required (<25 MGD/>25 MDG)	0	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**29,496,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	7.16	11.08	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	18		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	6.3	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	100		Input by Engineer
Construction Cost (PS / Force Main) $	**2,498,000**	**$ 26,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	86.81		Peak Flow / # drop shaft
Diameter (In)	66		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	-		75' per drop shaft
Average Depth (Ft)	-		Input by Engineer
Construction Cost (Consolidation Pipe) $	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	1,797,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	89,850		= ACH x Volume / 60
Construction Cost (Odor Control) $	**3,109,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	7.16		Ref: CSO Statistics
Construction Cost (Screening) $	**744,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	7.16		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	3.58		= Peak Vol/DW Time
Construction Cost $	**9,739,308**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	3		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**3,855,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	7,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	1,791		250 SF / MGD
Land Required - Odor Control (SF)	4,493		500 SF / 10,000 CFM
Land Required - Screening (SF)	1,791		250 SF / MGD
Land Required - Regulator (SF)	30,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*46,000*		
Land Required Cost (/ SF) $	2		Ref: Technical Parameters
Land Acquisition Cost $	**92,000**		
		SUBTOTAL CAPITAL COST $	**49,559,308**

Capital Costs

RIVER CROSSING #1 - Microtunnel - N/A			
86 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
86 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
86 Overflows / Year			
1.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
2.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
3. C-25			
Surface Storage	4.25 MG	11,751,000	Size & Cost by Engineer (from Regional Alts)
4. C-26A to C-29			
Screening & Disinifection	11.64 MGD	6,563,000	Size & Cost by Engineer (from Regional Alts)
5.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
6. Bells Run Region			
Sub-Surface Storage	NA	28,298,568	Size & Cost by Engineer (from Regional Alts)
7.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
8.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
9.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
10.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
		SUBTOTAL CAPITAL COST	**$ 46,612,568**

TOTAL CAPITAL COST $ 113,837,876

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	92	
Peak Volume	1,870,492	CF
	13.99	MG
Total Volume	36,266,468	CF
	271.27	MG
Peak Rate	359.79	CFS
	232.52	MGD

CONSOLIDATION SEWERS - Total	
92 Overflows / Year	
SUBTOTAL CAPITAL COST $	**46,289,000**

Capital Costs

TUNNEL STORAGE (C-2 through C-29)			
92 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	13.99	1,870,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	17.49	2,338,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	11		Input by Engineer
Tunnel Volume / Ft length (CF)	94.99		Ref: Tunnel diameter
Tunnel Length (Ft)	24,614		= Req'd Fac Vol / Vol per Ft Length; Target length is 24,462 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	12	5	
Additional Drop Shafts Required (<25 MGD/>25 MDG)	0	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**60,341,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	13.99	21.65	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	26		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	5.9	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	100		Input by Engineer
Construction Cost (PS / Force Main) $	**3,590,000**	**$ 34,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	71.96		Peak Flow / # drop shaft
Diameter (In)	66		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	-		75' per drop shaft
Average Depth (Ft)	-		Input by Engineer
Construction Cost (Consolidation Pipe) $	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	3,507,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	175,350		= ACH x Volume / 60
Construction Cost (Odor Control) $	**5,250,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	13.99		Ref: CSO Statistics
Construction Cost (Screening) $	**1,060,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	13.99		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	7.00		= Peak Vol/DW Time
Construction Cost $	**11,399,775**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	5		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**6,425,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	12,500		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	3,498		250 SF / MGD
Land Required - Odor Control (SF)	8,768		500 SF / 10,000 CFM
Land Required - Screening (SF)	3,498		250 SF / MGD
Land Required - Regulator (SF)	50,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*78,000*		
Land Required Cost (/ SF)	$ 2		Ref: Technical Parameters
Land Acquisition Cost $	**156,000**		
		SUBTOTAL CAPITAL COST $	**88,255,775**

RIVER CROSSING #1 - Microtunnel - N/A			
92 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
92 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

Capital Costs

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
92 Overflows / Year			
1.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
2.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
3.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
4.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
5.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
6.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
7.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
8.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
9.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
10.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
	SUBTOTAL CAPITAL COST	**$**	**-**

TOTAL CAPITAL COST $ 134,544,775

Capital Costs

Capital Costs

Capital Costs

Capital Costs

Operation and Maintenance Costs

System Wide Alternative CC-1							
CONSOLIDATION SEWERS - Total							
TUNNEL STORAGE (C-2 through C-13A)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	7.16	$70,040	20	10.910	$764,127
	Tunnel Maintenance	Length (ft)	11540	$3,693	50	14.484	$53,483
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	3	$159,050	50	14.484	$2,303,608
	Screening O&M	Flow Rate (MGD)	7.16	$8,039	20	10.910	$87,700
	Odor Control O&M	Capacity (CFM)	89,850	$314,475	20	10.910	$3,430,903
	Reserve / Replace	10% Gravity / 15% Pump					$20,672
			Subtotal Annual O&M	**$556,000**		**Subtotal PW O&M**	**$6,661,000**

Subsystem Components	
C-25	$298,000
C-26A to C-29	$178,000
Bells Run Region	$68,000
$0	$183,000
TOTAL ANNUAL O&M	**$1,283,000**
ANNUAL O&M ($MM)	**$1.28**

RIVER CROSSING #1 - Microtunnel

RIVER CROSSING #2 - Microtunnel

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS

Operation and Maintenance Costs

System Wide Alternative CC-2							
CONSOLIDATION SEWERS - Total							
TUNNEL STORAGE (C-2 through C-29)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	13.99	$109,556	20	10.910	$1,195,248
	Tunnel Maintenance	Length (ft)	24614	$7,877	50	14.484	$114,082
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	5	$165,083	50	14.484	$2,390,988
	Screening O&M	Flow Rate (MGD)	13.99	$8,631	20	10.910	$94,164
	Odor Control O&M	Capacity (CFM)	175,350	$613,725	20	10.910	$6,695,702
	Reserve / Replace	10% Gravity / 15% Pump					$31,810
			Subtotal Annual O&M	**$905,000**		**Subtotal PW O&M**	**$10,522,000**

Subsystem Components

TOTAL ANNUAL O&M	**$905,000**
ANNUAL O&M ($MM)	**$0.91**

RIVER CROSSING #1 - Microtunnel

RIVER CROSSING #2 - Microtunnel

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name CC-1
Structures within Region #N/A
Model ID CC-1.1
Structure Type
PWSA Sewershed
Stream of Discharge
NPDES Permit Number
Owner

Model Network (07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run 2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	86
Peak Volume:	3,065,009 ft^3
	22.93 MG
Total Volume:	18,424,172 ft^3
	137.82 MG
Peak Rate:	723.74 cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/5/2005 0:36	5432	1/8/2005 5:15	3065008.91	22927.799	0	52.40	21
4/22/2005 15:52	1463	4/23/2005 3:45	1267013.00	9477.891	1	430.81	1
7/5/2005 16:02	246	7/5/2005 16:30	1146647.57	8577.497	2	723.74	0
1/11/2005 7:47	1466	1/11/2005 9:00	987531.35	7387.228	3	44.52	25
2/14/2005 4:53	2424	2/14/2005 10:00	957507.51	7162.635	4	24.73	42
4/1/2005 19:18	2735	4/2/2005 9:45	785929.43	5879.145	5	44.82	23
5/13/2005 22:31	1622	5/14/2005 16:15	753347.19	5635.414	6	169.00	9
10/24/2005 13:08	1959	10/25/2005 4:00	736779.05	5511.476	7	35.80	27
1/3/2005 8:10	1649	1/3/2005 13:45	703787.53	5264.683	8	29.90	35
7/15/2005 17:31	139	7/15/2005 18:15	696736.21	5211.935	9	260.42	4
8/20/2005 18:02	191	8/20/2005 19:00	694308.30	5193.773	10	342.21	2
7/12/2005 18:47	135	7/12/2005 20:00	675172.32	5050.627	11	273.57	3
11/29/2005 1:50	1030	11/29/2005 11:15	644252.92	4819.334	12	56.73	19
3/28/2005 7:48	1641	3/28/2005 20:00	566351.49	4236.592	13	33.73	29
11/14/2005 21:35	593	11/15/2005 1:30	557774.43	4172.432	14	75.56	16
6/11/2005 17:30	273	6/11/2005 18:00	437510.71	3272.799	15	240.95	5
7/26/2005 19:30	488	7/26/2005 20:00	287905.76	2153.679	16	195.15	6
1/12/2005 22:16	2263	1/14/2005 2:00	274628.56	2054.359	17	22.21	44
9/29/2005 5:02	161	9/29/2005 5:45	257387.86	1925.390	18	171.48	8
5/11/2005 22:30	141	5/11/2005 22:45	194796.49	1457.175	19	92.83	12
2/20/2005 15:17	1242	2/20/2005 20:00	188718.16	1411.706	20	52.77	20
5/28/2005 8:23	662	5/28/2005 9:00	177849.25	1330.401	21	41.09	26
3/23/2005 2:35	723	3/23/2005 12:30	177395.05	1327.004	22	32.68	31
12/15/2005 11:02	714	12/15/2005 14:00	176572.00	1320.847	23	44.58	24
8/29/2005 9:00	412	8/29/2005 9:30	169662.94	1269.164	24	61.08	18
11/9/2005 19:15	108	11/9/2005 19:30	165435.07	1237.537	25	186.42	7
5/23/2005 16:15	128	5/23/2005 16:30	141812.97	1060.832	26	166.80	10
7/17/2005 15:50	122	7/17/2005 16:15	123012.02	920.191	27	81.66	14
10/7/2005 7:06	394	10/7/2005 10:45	117088.81	875.883	28	28.82	37
7/25/2005 13:01	49	7/25/2005 13:15	112342.32	840.377	29	93.10	11
2/9/2005 14:59	164	2/9/2005 16:45	101757.35	761.196	30	35.59	28
10/21/2005 18:45	214	10/21/2005 19:00	91988.07	688.117	31	21.22	46
10/22/2005 7:02	693	10/22/2005 16:45	80704.79	603.712	32	22.36	43

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
4/20/2005 18:38	336	4/20/2005 23:15	79093.92	591.662	33	29.64	36
2/16/2005 6:53	844	2/16/2005 7:15	74710.04	558.868	34	26.54	40
9/26/2005 6:58	309	9/26/2005 9:45	68962.90	515.877	35	31.89	33
4/30/2005 4:33	154	4/30/2005 6:45	60771.92	454.604	36	21.75	45
11/1/2005 14:45	212	11/1/2005 16:15	59080.76	441.954	37	15.00	48
3/24/2005 9:30	122	3/24/2005 9:45	55678.97	416.507	38	78.09	15
6/28/2005 18:01	64	6/28/2005 18:15	55135.62	412.442	39	81.73	13
7/21/2005 14:21	82	7/21/2005 14:45	53592.58	400.899	40	50.40	22
7/13/2005 15:45	38	7/13/2005 16:00	47915.30	358.430	41	66.91	17
6/14/2005 18:47	78	6/14/2005 19:30	45443.31	339.939	42	30.46	34
5/20/2005 3:11	448	5/20/2005 7:30	36063.95	269.776	43	8.62	52
3/27/2005 16:46	124	3/27/2005 17:15	31138.01	232.928	44	11.60	50
12/25/2005 10:47	211	12/25/2005 13:00	29842.94	223.240	45	12.46	49
8/27/2005 15:15	118	8/27/2005 15:30	28515.58	213.311	46	31.98	32
8/26/2005 20:46	44	8/26/2005 21:00	22393.69	167.516	47	26.78	39
6/10/2005 21:16	40	6/10/2005 21:30	19859.11	148.556	48	33.15	30
11/6/2005 13:49	26	11/6/2005 14:00	17560.86	131.364	49	27.92	38
11/16/2005 4:03	459	11/16/2005 4:15	17074.09	127.723	50	11.34	51
7/17/2005 8:49	30	7/17/2005 9:00	12953.12	96.896	51	25.98	41
3/7/2005 22:11	221	3/7/2005 23:45	10616.80	79.419	52	2.46	65
3/20/2005 7:06	92	3/20/2005 7:30	10452.88	78.193	53	8.29	53
5/7/2005 12:06	103	5/7/2005 13:30	9178.42	68.659	54	16.44	47
2/26/2005 13:01	114	2/26/2005 14:00	8380.25	62.688	55	5.62	58
11/9/2005 4:06	47	11/9/2005 4:20	8370.21	62.613	56	5.72	57
4/27/2005 0:20	49	4/27/2005 0:30	8081.61	60.454	57	6.99	55
5/30/2005 19:10	49	5/30/2005 19:15	7441.93	55.669	58	4.50	60
9/23/2005 2:41	28	9/23/2005 3:00	5608.16	41.952	59	7.74	54
11/8/2005 14:36	31	11/8/2005 14:45	5033.89	37.656	60	6.08	56
11/23/2005 19:45	40	11/23/2005 20:15	4468.89	33.430	61	3.75	61
5/24/2005 21:03	43	5/24/2005 21:30	4104.46	30.703	62	3.45	62
2/25/2005 13:08	93	2/25/2005 13:45	3864.92	28.912	63	1.37	69
6/3/2005 8:56	71	6/3/2005 9:15	3669.70	27.451	64	4.50	59
1/30/2005 11:07	62	1/30/2005 11:20	2674.84	20.009	65	1.30	71
9/16/2005 8:51	31	9/16/2005 9:05	2672.64	19.993	66	3.04	63
8/16/2005 6:35	33	8/16/2005 6:45	2163.56	16.185	67	1.56	68
4/24/2005 14:48	74	4/24/2005 15:05	1823.07	13.638	68	0.71	74
3/12/2005 11:11	68	3/12/2005 11:45	1806.13	13.511	69	1.34	70
11/24/2005 8:02	232	11/24/2005 8:20	916.58	6.856	70	1.61	67
1/26/2005 7:55	159	1/26/2005 9:00	777.08	5.813	71	0.40	78
3/11/2005 13:38	33	3/11/2005 14:00	654.03	4.893	72	0.52	77
10/21/2005 7:30	11	10/21/2005 7:35	554.40	4.147	73	1.78	66
8/8/2005 8:55	22	8/8/2005 9:05	479.24	3.585	74	0.78	73
6/16/2005 16:36	15	6/16/2005 16:45	276.88	2.071	75	0.65	75
8/5/2005 11:24	13	8/5/2005 11:30	253.59	1.897	76	0.58	76
2/24/2005 19:07	14	2/24/2005 19:15	192.39	1.439	77	0.39	79
10/24/2005 2:54	29	10/24/2005 3:20	153.28	1.147	78	0.27	80
10/26/2005 10:26	7	10/26/2005 10:30	54.37	0.407	79	0.21	81
6/6/2005 9:28	8	6/6/2005 9:30	38.10	0.285	80	0.11	84
6/17/2005 1:29	7	6/17/2005 1:35	29.27	0.219	81	0.09	85
1/22/2005 10:24	84	1/22/2005 11:15	-18.89	-0.141	82	0.21	82
2/8/2005 5:56	82	2/8/2005 7:15	-882.12	-6.599	83	0.20	83
12/26/2005 5:59	306	12/26/2005 6:15	-2231.47	-16.693	84	0.86	72
1/15/2005 5:09	913	1/15/2005 14:25	-7989.12	-59.763	85	2.47	64

Region 1

PWSA CSO DISCHARGES for "Typical Year - 2005" Base Line Condition

Region Name	CC-1
Structures within Region	#N/A
Model ID	CC-1.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	86
Peak Volume:	3,065,009 ft^3
	22.93 MG
Total Volume:	18,424,172 ft^3
	137.82 MG
Peak Rate:	723.74 cfs

Figure 1 - CC-1 Region CSO Volume

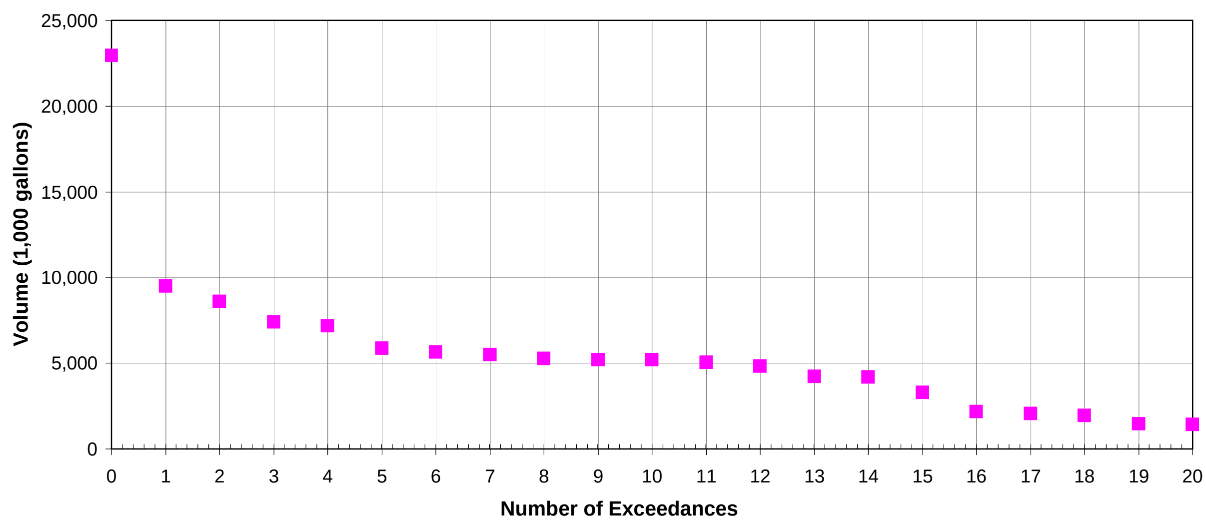
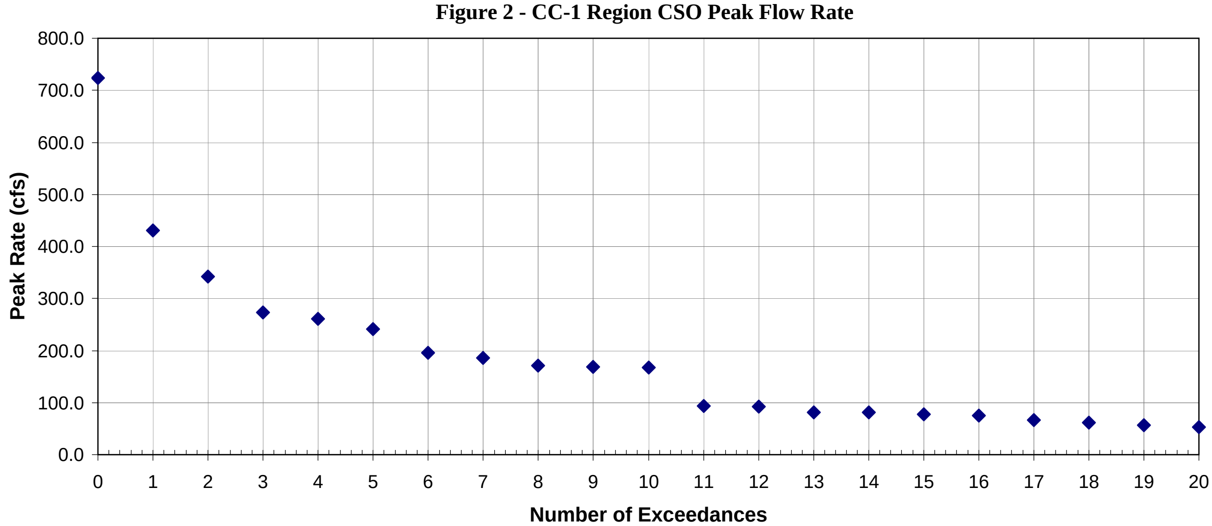


Figure 2 - CC-1 Region CSO Peak Flow Rate



Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	CC-2
Structures within Region	#N/A
Model ID	CC-2.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	

Results Summary

Number of Events:	92	
Peak Volume:	8,137,654	ft^3
	60.87	MG
Total Volume:	36,266,468	ft^3
	271.29	MG
Peak Rate:	759.72	cfs

Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/3/2005 4:48	9202	1/5/2005 14:45	8137654.16	60873.722	0	95.62	17
1/11/2005 7:46	5196	1/12/2005 1:30	2897704.34	21676.277	1	70.43	24
2/14/2005 4:47	2556	2/14/2005 14:45	2037072.05	15238.317	2	43.74	33
5/13/2005 22:30	2507	5/14/2005 16:15	1893561.04	14164.783	3	296.16	6
4/22/2005 15:50	4226	4/23/2005 3:45	1870491.80	13992.214	4	489.89	1
4/1/2005 19:15	3073	4/2/2005 6:30	1778965.82	13307.554	5	72.02	23
3/28/2005 7:43	2372	3/28/2005 10:15	1464191.29	10952.883	6	58.76	28
7/5/2005 16:02	348	7/5/2005 16:30	1444816.61	10807.951	7	759.72	0
10/24/2005 11:47	2071	10/25/2005 2:30	1420237.61	10624.087	8	53.23	30
11/29/2005 1:45	1944	11/29/2005 11:15	1238053.88	9261.262	9	88.86	19
6/11/2005 17:20	394	6/11/2005 17:45	1103527.28	8254.936	10	452.34	3
8/20/2005 18:02	267	8/20/2005 19:00	1035999.24	7749.792	11	455.37	2
11/14/2005 21:34	900	11/15/2005 1:30	973615.46	7283.130	12	98.41	15
7/15/2005 17:30	140	7/15/2005 18:15	898431.45	6720.716	13	334.87	5
7/12/2005 18:47	135	7/12/2005 20:00	684849.72	5123.018	14	276.79	7
7/26/2005 19:30	512	7/26/2005 20:00	594079.78	4444.014	15	359.79	4
2/20/2005 15:08	1876	2/20/2005 20:00	550974.27	4121.563	16	74.73	22
12/15/2005 10:06	2083	12/15/2005 14:00	539452.40	4035.374	17	75.68	21
3/23/2005 2:30	2030	3/24/2005 9:45	484827.45	3626.752	18	79.19	20
9/29/2005 5:03	218	9/29/2005 5:45	429013.62	3209.236	19	273.22	8
5/28/2005 8:16	794	5/28/2005 9:00	339545.39	2539.969	20	60.81	27
8/29/2005 9:00	452	8/29/2005 9:30	328826.45	2459.786	21	89.02	18
5/11/2005 22:30	142	5/11/2005 22:45	318722.16	2384.201	22	122.86	12
11/9/2005 19:15	107	11/9/2005 19:30	267577.17	2001.611	23	211.86	9
2/16/2005 5:39	1041	2/16/2005 7:15	236628.81	1770.102	24	30.02	41
10/7/2005 7:06	628	10/7/2005 10:45	227385.56	1700.958	25	48.43	32
2/9/2005 14:39	537	2/9/2005 16:45	219267.10	1640.228	26	62.05	26
5/23/2005 16:15	130	5/23/2005 16:30	207136.04	1549.481	27	203.90	10
7/17/2005 15:50	149	7/17/2005 16:15	198362.08	1483.848	28	97.92	16
10/22/2005 6:24	757	10/22/2005 16:45	191064.76	1429.260	29	38.67	35
10/21/2005 18:42	235	10/21/2005 19:15	188356.76	1409.003	30	31.99	38
7/21/2005 14:16	111	7/21/2005 14:45	171985.54	1286.538	31	125.68	11
4/30/2005 4:26	834	4/30/2005 6:45	168261.10	1258.677	32	28.29	42

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
7/25/2005 13:01	90	7/25/2005 13:30	150965.29	1129.296	33	100.03	14
9/26/2005 6:11	366	9/26/2005 9:45	140444.06	1050.592	34	53.70	29
4/20/2005 18:38	354	4/20/2005 23:15	121984.02	912.501	35	30.24	40
11/1/2005 14:45	238	11/1/2005 16:30	109880.04	821.958	36	23.14	46
5/20/2005 3:11	551	5/20/2005 7:30	105806.95	791.489	37	13.10	52
6/28/2005 18:00	95	6/28/2005 18:15	86932.61	650.299	38	104.79	13
3/27/2005 16:42	349	3/27/2005 17:15	77633.55	580.738	39	20.11	48
11/16/2005 4:01	513	11/16/2005 4:15	74215.59	555.170	40	24.45	45
12/25/2005 9:51	272	12/25/2005 13:00	66653.87	498.604	41	20.97	47
8/27/2005 15:05	128	8/27/2005 15:30	64835.62	485.003	42	51.99	31
6/14/2005 18:47	95	6/14/2005 19:30	64383.92	481.624	43	36.57	36
8/26/2005 20:46	79	8/26/2005 21:00	49105.44	367.333	44	40.50	34
7/13/2005 15:45	38	7/13/2005 16:00	48493.37	362.755	45	67.23	25
5/30/2005 19:10	230	5/30/2005 19:45	46058.46	344.540	46	13.54	51
2/26/2005 10:01	597	2/26/2005 14:00	46014.03	344.208	47	9.56	57
12/26/2005 5:01	482	12/26/2005 11:05	41770.26	312.462	48	3.19	67
5/7/2005 11:58	136	5/7/2005 13:30	40379.47	302.059	49	30.66	39
3/7/2005 21:51	431	3/8/2005 0:25	39224.83	293.421	50	4.47	63
4/26/2005 20:20	838	4/27/2005 0:30	37491.65	280.456	51	12.39	53
11/9/2005 4:06	87	11/9/2005 4:30	29851.45	223.304	52	18.67	49
3/20/2005 3:42	337	3/20/2005 7:30	28455.54	212.862	53	14.25	50
10/21/2005 7:15	123	10/21/2005 7:30	24202.00	181.043	54	10.42	56
6/3/2005 8:18	121	6/3/2005 9:15	20783.07	155.468	55	12.02	54
8/8/2005 8:40	69	8/8/2005 9:00	20110.52	150.437	56	11.02	55
6/10/2005 21:16	39	6/10/2005 21:30	19885.11	148.751	57	33.17	37
11/6/2005 10:13	261	11/6/2005 14:00	16995.39	127.134	58	28.22	43
1/30/2005 1:46	753	1/30/2005 11:35	16306.63	121.982	59	4.81	62
11/8/2005 10:57	294	11/8/2005 14:45	15731.98	117.683	60	6.96	59
1/22/2005 8:24	264	1/22/2005 11:35	15623.67	116.873	61	4.23	64
11/23/2005 19:20	206	11/23/2005 20:15	14012.72	104.822	62	6.57	61
11/24/2005 5:58	394	11/24/2005 8:20	13792.77	103.177	63	2.56	71
8/5/2005 10:57	138	8/5/2005 11:30	13737.71	102.765	64	6.81	60
7/17/2005 8:49	30	7/17/2005 9:00	12978.97	97.089	65	25.99	44
10/24/2005 2:05	117	10/24/2005 3:20	10801.21	80.798	66	2.71	70
9/23/2005 2:41	51	9/23/2005 3:00	7128.22	53.323	67	8.19	58
6/17/2005 1:26	93	6/17/2005 1:55	5281.64	39.509	68	1.99	73
9/16/2005 21:33	50	9/16/2005 22:05	5088.44	38.064	69	4.03	65
5/24/2005 21:03	43	5/24/2005 21:30	4135.14	30.933	70	3.46	66
2/25/2005 13:08	93	2/25/2005 13:45	3974.17	29.729	71	1.39	79
3/12/2005 11:01	93	3/12/2005 11:45	3749.09	28.045	72	1.76	75
9/16/2005 8:51	43	9/16/2005 9:05	3489.29	26.102	73	3.05	68
8/16/2005 6:35	33	8/16/2005 6:45	2189.61	16.379	74	1.57	77
12/4/2005 5:51	572	12/4/2005 7:05	2147.53	16.065	75	2.97	69
1/26/2005 7:55	164	1/26/2005 9:00	2056.95	15.387	76	0.49	84
12/11/2005 19:31	48	12/11/2005 20:05	1361.23	10.183	77	1.00	81
2/10/2005 6:04	249	2/10/2005 9:45	794.10	5.940	78	0.15	89
2/8/2005 5:50	434	2/8/2005 6:20	719.63	5.383	79	1.80	74
1/15/2005 8:03	734	1/15/2005 14:25	680.05	5.087	80	2.49	72
6/6/2005 9:28	59	6/6/2005 10:05	441.08	3.300	81	0.43	85
8/28/2005 11:55	9	8/28/2005 12:00	431.33	3.227	82	1.57	76
5/19/2005 19:57	18	5/19/2005 20:05	265.13	1.983	83	0.38	86
6/22/2005 5:26	78	6/22/2005 5:40	149.30	1.117	84	1.08	80
3/20/2005 16:08	12	3/20/2005 16:15	117.34	0.878	85	0.26	87
10/26/2005 10:26	7	10/26/2005 10:30	58.23	0.436	86	0.23	88

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/19/2005 7:39	158	1/19/2005 7:45	-229.13	-1.714	87	0.10	90

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
2/24/2005 18:58	190	2/24/2005 21:55	-388.14	-2.903	88	0.67	83
3/11/2005 7:39	438	3/11/2005 14:00	-1045.38	-7.820	89	0.75	82
2/24/2005 6:39	141	2/24/2005 8:55	-1119.96	-8.378	90	0.08	91
6/16/2005 11:43	308	6/16/2005 13:00	-1186.50	-8.876	91	1.40	78

Exceedance Summary

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	CC-2	**Results Summary**	
Structures within Region	#N/A	Number of Events:	92
Model ID	CC-2.1	Peak Volume:	8,137,654 ft^3
Structure Type			60.87 MG
PWSA Sewershed		Total Volume:	36,266,468 ft^3
Stream of Discharge			271.29 MG
NPDES Permit Number		Peak Rate:	759.72 cfs
Owner			

Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Figure 1 - CC-2 Region CSO Volume

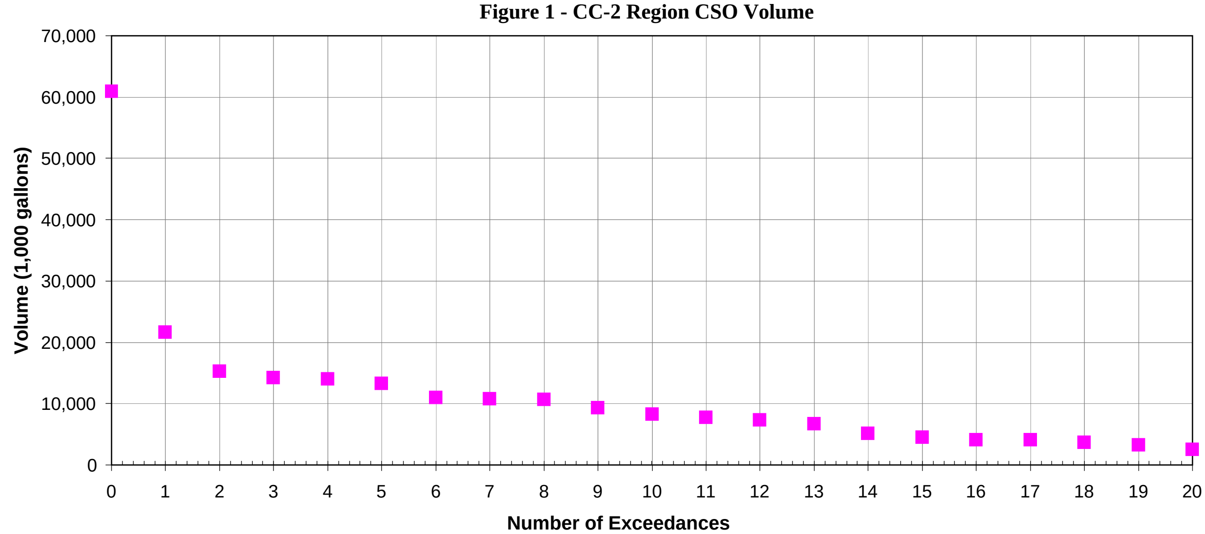
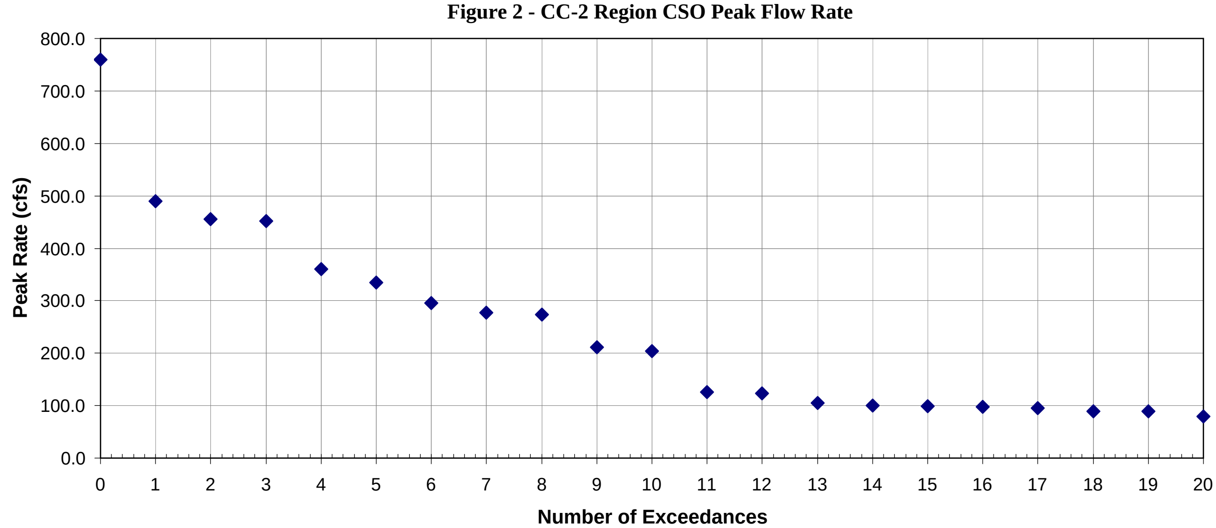


Figure 2 - CC-2 Region CSO Peak Flow Rate



Alternative Menu

NOTE: All PW Costs are in million $; all capital costs are in $.

CC-3				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 68,011,000
TUNNEL STORAGE (C-2 through C-13A)				
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	93	
Peak Volume	2,440,520	CF
	18.26	MG
Total Volume	56,578,337	CF
	423.21	MG
Peak Rate	632.69	CFS
	408.89	MGD

CONSOLIDATION SEWERS - Total	
93 Overflows / Year	
SUBTOTAL CAPITAL COST $	68,011,000

TUNNEL STORAGE (C-2 through C-13A)			
93 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	18.26	2,441,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	22.82	3,051,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	12.5		Input by Engineer
Tunnel Volume / Ft length (CF)	122.66		Ref: Tunnel diameter
Tunnel Length (Ft)	24,874		= Req'd Fac Vol / Vol per Ft Length; Target length is 24,462 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	12	6	
Additional Drop Shafts Required (<25 MGD/>25 MDG)	0	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**69,125,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	18.26	28.25	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	29		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	6.2	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	100		Input by Engineer
Construction Cost (PS / Force Main) $	**4,689,000**	**$ 37,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	105.45		Peak Flow / # drop shaft
Diameter (In)	78		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	-		75' per drop shaft
Average Depth (Ft)	-		Input by Engineer
Construction Cost (Consolidation Pipe) $	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	4,577,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	228,850		= ACH x Volume / 60
Construction Cost (Odor Control) $	**6,468,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	18.26		Ref: CSO Statistics
Construction Cost (Screening) $	**1,258,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	18.26		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	9.13		= Peak Vol/DW Time
Construction Cost $	**12,437,506**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	6		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**7,710,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	15,000		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	4,564		250 SF / MGD
Land Required - Odor Control (SF)	11,443		500 SF / 10,000 CFM
Land Required - Screening (SF)	4,564		250 SF / MGD
Land Required - Regulator (SF)	60,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*96,000*		
Land Required Cost (/ SF) $	2		Ref: Technical Parameters
Land Acquisition Cost $	**192,000**		
		SUBTOTAL CAPITAL COST $	**101,916,506**

Capital Costs

RIVER CROSSING #1 - Microtunnel - N/A			
93 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
93 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
		SUBTOTAL CAPITAL COST	**$ -**

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
93 Overflows / Year			
1.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
2.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
3.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
4.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
5.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
6.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
7.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
8.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
9.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
10.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
		SUBTOTAL CAPITAL COST	**$ -**

TOTAL CAPITAL COST $ 169,927,506

Operation and Maintenance Costs

Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)							
CONSOLIDATION SEWERS - Total							
TUNNEL STORAGE (C-2 through C-13A)							
0	**Requirement**	**Input Parameter**	**Input Value**	**Annual O&M Cost**	**Service Life (Yr)**	**Present Worth Factor**	**Present Worth**
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	18.26	$130,864	20	10.910	$1,427,715
	Tunnel Maintenance	Length (ft)	24874	$7,960	50	14.484	$115,287
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	6	$168,099	50	14.484	$2,434,677
	Screening O&M	Flow Rate (MGD)	18.26	$9,010	20	10.910	$98,294
	Odor Control O&M	Capacity (CFM)	228,850	$800,975	20	10.910	$8,738,589
	Reserve / Replace	10% Gravity / 15% Pump					$40,146
			Subtotal Annual O&M	**$1,117,000**		**Subtotal PW O&M**	**$12,855,000**

Subsystem Components

TOTAL ANNUAL O&M	**$1,117,000**
ANNUAL O&M ($MM)	**$1.12**

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	CC-3
Structures within Region	#N/A
Model ID	CC-3.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	93	
Peak Volume:	12,708,668	ft^3
	95.07	MG
Total Volume:	56,578,337	ft^3
	423.23	MG
Peak Rate:	1366.13	cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/3/2005 4:48	9202	1/5/2005 14:45	12708668.14	95067.192	0	177.35	18
1/11/2005 7:45	5197	1/12/2005 1:30	4232010.14	31657.552	1	141.56	24
5/13/2005 22:30	2507	5/14/2005 16:15	2934236.58	21949.557	2	736.46	3
2/14/2005 4:46	2557	2/14/2005 14:45	2850549.44	21323.535	3	68.95	37
4/22/2005 15:46	4230	4/23/2005 3:45	2440519.91	18256.309	4	632.69	4
10/24/2005 11:47	2071	10/25/2005 2:30	2378366.15	17791.368	5	94.21	30
4/1/2005 19:15	3073	4/2/2005 6:30	2315656.44	17322.268	6	136.05	26
7/5/2005 16:01	349	7/5/2005 16:30	2288680.70	17120.476	7	1366.13	0
11/29/2005 1:45	1944	11/29/2005 11:15	1986706.82	14861.560	8	163.30	21
3/28/2005 7:43	2372	3/28/2005 10:15	1891762.27	14151.328	9	95.16	28
11/14/2005 21:31	903	11/15/2005 3:45	1853767.67	13867.109	10	254.91	12
6/11/2005 17:20	394	6/11/2005 18:00	1840166.44	13765.365	11	891.61	1
8/20/2005 18:00	268	8/20/2005 19:00	1748575.00	13080.215	12	813.12	2
7/15/2005 17:30	140	7/15/2005 18:15	1323956.56	9903.857	13	502.21	8
7/12/2005 18:45	137	7/12/2005 20:00	1310414.75	9802.558	14	598.66	6
7/26/2005 19:30	512	7/26/2005 20:00	924754.20	6917.624	15	631.77	5
3/23/2005 2:30	2031	3/24/2005 9:45	834092.36	6239.428	16	186.37	16
9/29/2005 5:01	219	9/29/2005 5:45	821631.67	6146.216	17	582.97	7
12/15/2005 10:06	2083	12/15/2005 14:00	787409.46	5890.216	18	168.57	20
2/20/2005 15:08	1876	2/20/2005 20:00	713943.54	5340.655	19	143.99	23
8/29/2005 9:00	452	8/29/2005 13:00	648748.88	4852.966	20	175.06	19
5/28/2005 8:16	794	5/28/2005 9:15	601642.31	4500.585	21	122.91	27
5/11/2005 22:30	143	5/11/2005 22:45	585201.26	4377.598	22	221.93	14
11/9/2005 19:15	107	11/9/2005 19:30	441921.54	3305.794	23	361.47	10
5/23/2005 16:15	130	5/23/2005 16:30	440395.86	3294.381	24	491.72	9
10/7/2005 7:05	628	10/7/2005 10:45	389043.02	2910.236	25	93.27	31
2/9/2005 14:39	537	2/9/2005 16:45	385424.73	2883.170	26	137.85	25
10/21/2005 18:41	235	10/21/2005 19:15	367061.41	2745.803	27	68.13	39
7/17/2005 15:50	149	7/17/2005 16:15	363827.13	2721.609	28	220.26	15
10/22/2005 6:24	757	10/22/2005 16:45	331157.63	2477.225	29	69.21	36
7/21/2005 14:15	112	7/21/2005 14:45	315450.79	2359.730	30	265.74	11
2/16/2005 5:39	1041	2/16/2005 7:20	295798.65	2212.722	31	42.06	46
7/25/2005 13:00	91	7/25/2005 13:30	273706.32	2047.460	32	221.96	13

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
4/30/2005 4:25	834	4/30/2005 6:45	267450.48	2000.663	33	54.34	42
9/26/2005 6:11	366	9/26/2005 9:45	264833.06	1981.084	34	94.43	29
4/20/2005 18:35	356	4/20/2005 21:30	249581.65	1866.996	35	55.47	41
5/20/2005 3:01	561	5/20/2005 7:30	232098.90	1736.216	36	34.95	49
11/1/2005 14:40	243	11/1/2005 16:30	217454.19	1626.666	37	47.94	43
6/28/2005 18:00	95	6/28/2005 18:15	147164.82	1100.866	38	180.52	17
6/14/2005 18:45	96	6/14/2005 19:30	138638.60	1037.086	39	72.19	34
11/16/2005 4:00	513	11/16/2005 4:15	135689.15	1015.023	40	85.97	33
8/27/2005 15:05	128	8/27/2005 15:30	124232.45	929.321	41	153.23	22
3/27/2005 16:42	349	3/27/2005 17:15	119607.47	894.724	42	43.01	45
12/25/2005 9:51	272	12/25/2005 13:00	114855.04	859.173	43	43.43	44
8/26/2005 20:45	80	8/26/2005 21:00	101676.03	760.588	44	86.91	32
11/9/2005 4:01	93	11/9/2005 4:30	83516.58	624.746	45	67.08	40
5/7/2005 11:58	136	5/7/2005 13:30	64768.41	484.500	46	68.86	38
3/7/2005 21:51	431	3/8/2005 0:40	53366.91	399.211	47	7.52	61
3/20/2005 3:41	339	3/20/2005 7:30	51839.76	387.787	48	32.13	51
7/13/2005 15:45	39	7/13/2005 16:00	50126.42	374.971	49	69.84	35
4/26/2005 20:20	838	4/27/2005 0:40	47773.26	357.368	50	16.24	54
6/3/2005 8:18	121	6/3/2005 9:15	46319.98	346.497	51	39.83	48
2/26/2005 10:01	597	2/26/2005 14:00	46215.91	345.718	52	9.69	58
5/30/2005 19:10	230	5/30/2005 19:45	46058.46	344.540	53	13.54	55
12/26/2005 5:01	482	12/26/2005 11:05	42087.79	314.838	54	3.19	70
6/10/2005 21:15	40	6/10/2005 21:30	37391.66	279.708	55	41.52	47
8/8/2005 8:40	69	8/8/2005 9:05	31823.64	238.057	56	24.89	53
10/21/2005 7:15	123	10/21/2005 7:45	26459.67	197.932	57	13.18	56
1/30/2005 1:46	753	1/30/2005 11:40	23920.27	178.936	58	8.16	60
11/6/2005 10:13	261	11/6/2005 14:00	21376.64	159.908	59	33.15	50
11/23/2005 19:20	206	11/23/2005 20:20	17956.10	134.321	60	10.78	57
1/22/2005 8:24	264	1/22/2005 11:35	15942.68	119.259	61	4.23	66
11/24/2005 5:58	394	11/24/2005 8:15	15884.32	118.823	62	2.87	72
11/8/2005 10:57	294	11/8/2005 14:45	15731.98	117.683	63	6.96	63
7/17/2005 8:46	33	7/17/2005 9:00	15042.68	112.527	64	31.17	52
8/5/2005 10:57	138	8/5/2005 11:30	14288.73	106.887	65	7.31	62
10/24/2005 2:05	117	10/24/2005 3:25	12418.88	92.899	66	3.82	68
12/31/2005 23:00	60	12/31/2005 23:05	8242.42	61.657	67	2.40	74
9/23/2005 2:40	52	9/23/2005 3:00	7210.06	53.935	68	8.19	59
6/17/2005 1:25	94	6/17/2005 2:30	6075.35	45.447	69	2.14	75
5/24/2005 21:03	43	5/24/2005 21:30	5807.81	43.445	70	4.75	65
9/16/2005 8:46	47	9/16/2005 9:00	5515.74	41.261	71	5.82	64
9/16/2005 21:33	50	9/16/2005 22:05	5089.65	38.073	72	4.03	67
2/25/2005 13:06	95	2/25/2005 13:45	5038.31	37.689	73	1.74	78
8/16/2005 6:30	37	8/16/2005 6:45	4397.90	32.898	74	3.54	69
3/12/2005 11:01	93	3/12/2005 11:45	4069.15	30.439	75	2.12	76
1/26/2005 7:52	167	1/26/2005 9:00	2477.75	18.535	76	0.81	86
12/4/2005 5:51	572	12/4/2005 7:05	2324.03	17.385	77	2.97	71
12/11/2005 19:31	48	12/11/2005 20:05	1361.23	10.183	78	1.00	84
2/8/2005 5:47	437	2/8/2005 6:20	1229.84	9.200	79	1.80	77
2/10/2005 6:04	249	2/10/2005 9:45	794.10	5.940	80	0.15	90
1/15/2005 8:03	734	1/15/2005 14:25	708.78	5.302	81	2.49	73
10/26/2005 10:18	16	10/26/2005 10:30	453.69	3.394	82	0.81	85
6/6/2005 9:28	59	6/6/2005 10:05	441.08	3.300	83	0.43	87
8/28/2005 11:55	9	8/28/2005 12:00	431.33	3.227	84	1.57	79
5/19/2005 19:37	38	5/19/2005 20:05	270.19	2.021	85	0.38	88
6/22/2005 5:26	78	6/22/2005 5:40	149.30	1.117	86	1.08	82

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
3/20/2005 16:08	12	3/20/2005 16:15	117.34	0.878	87	0.26	89

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
2/24/2005 18:58	190	2/24/2005 19:15	-85.69	-0.641	88	1.01	83
1/19/2005 7:39	158	1/19/2005 7:45	-229.13	-1.714	89	0.10	91
3/11/2005 7:39	438	3/11/2005 14:00	-490.80	-3.671	90	1.08	81
6/16/2005 11:43	308	6/16/2005 13:00	-782.34	-5.852	91	1.40	80
2/24/2005 6:39	141	2/24/2005 8:55	-1119.96	-8.378	92	0.08	92

Exceedance Summary

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	CC-3
Structures within Region	#N/A
Model ID	CC-3.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	93	
Peak Volume:	12,708,668	ft^3
	95.07	MG
Total Volume:	56,578,337	ft^3
	423.23	MG
Peak Rate:	1366.13	cfs

Figure 1 - CC-3 Region CSO Volume

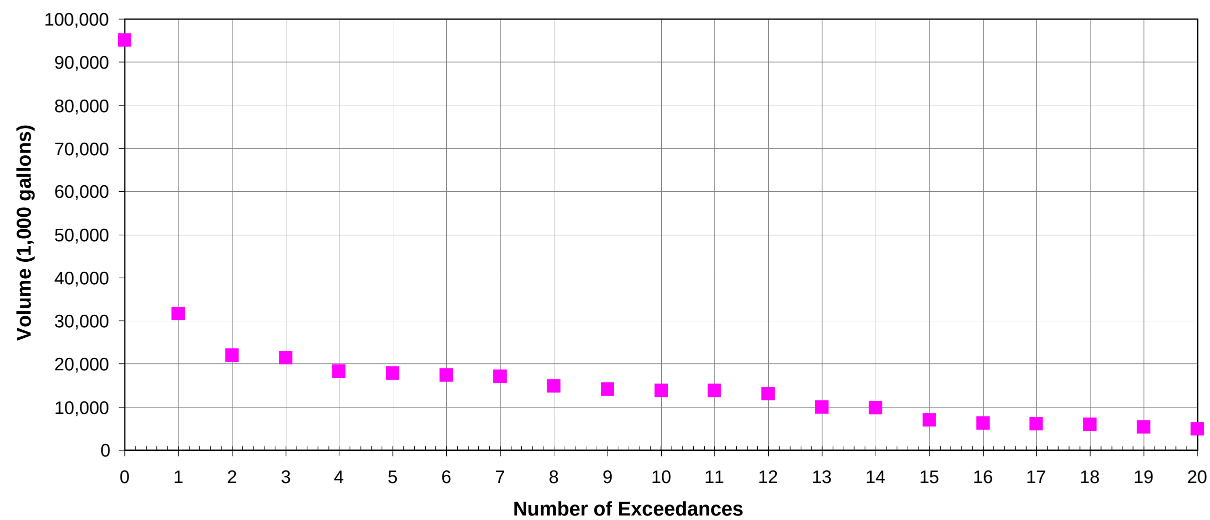
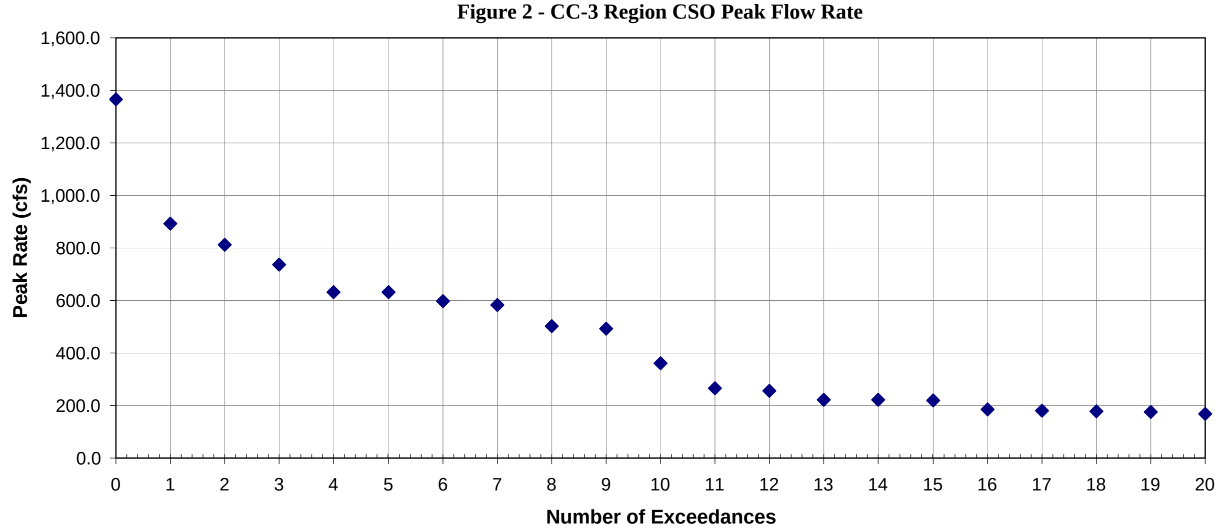


Figure 2 - CC-3 Region CSO Peak Flow Rate



F.5 CHARTIERS CREEK SUBSYSTEM

Description of Subsystem

The Chartiers Creek Subsystem is located along Chartiers Creek between the CSO structures C-02 and C-29. Also included in this subsystem is the Bells Run Region which extends from CSO structure 039E001 to 068H002 which is situated east of CSO structure C-25. Control of CSOs within this Subsystem will be based upon Tunnel Storage, in combination with the highest ranked outfall groupings in the areas not served by the Tunnel. This combination serves to control CSOs originating from the following outfalls and Regions.

- C-02 to C013A Region
- C-14 to C-15
- C-25
- C-26A to C-29
- Bells Run Region
- O-8 to O-13 Region*

*Applicable for Alternative CC-3 only

All of the Chartiers Creek outfalls currently convey overflows from each of the respective ALCOSAN diversion chambers to Chartiers Creek and, ultimately, the Ohio River. Outfalls O-8 through O-13 carry flow directly to the Ohio River.

The entire area that is encompassed in this alternative includes approximately 1,980 acres of residential, business and commercial users.

<u>Description of Alternatives</u>

In an effort to determine the most effective combination of controls for this Subsystem, three variations were developed and evaluated. They are labeled CC-1, CC-2, and CC-3. These subsystem variations were based upon a capture level of 4 CSO events per year. A brief description of each is given below.

Alternative CC-1

Alternative CC-1 is based upon Tunnel CC-1 having an approximate length of 11,500 feet. *Attachment 1 – Subsystem Alternative CC-1 Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and approximate location of the tunnel. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. The remainder of the overflows (outlier outfalls) in the Chartiers Subsystem will be controlled using the highest ranked CSO control technologies that were identified during the Outfall Specific and Regional Alternatives Evaluation process. Detailed descriptions of the Outfall Specific and Regional Alternatives may be found in Appendices D and E.

Tunnel CC-1 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 22.93 MG to 5.64 MG for control levels of 0 to 6 overflow events, respectively. *Figure 1 – CC-1 Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

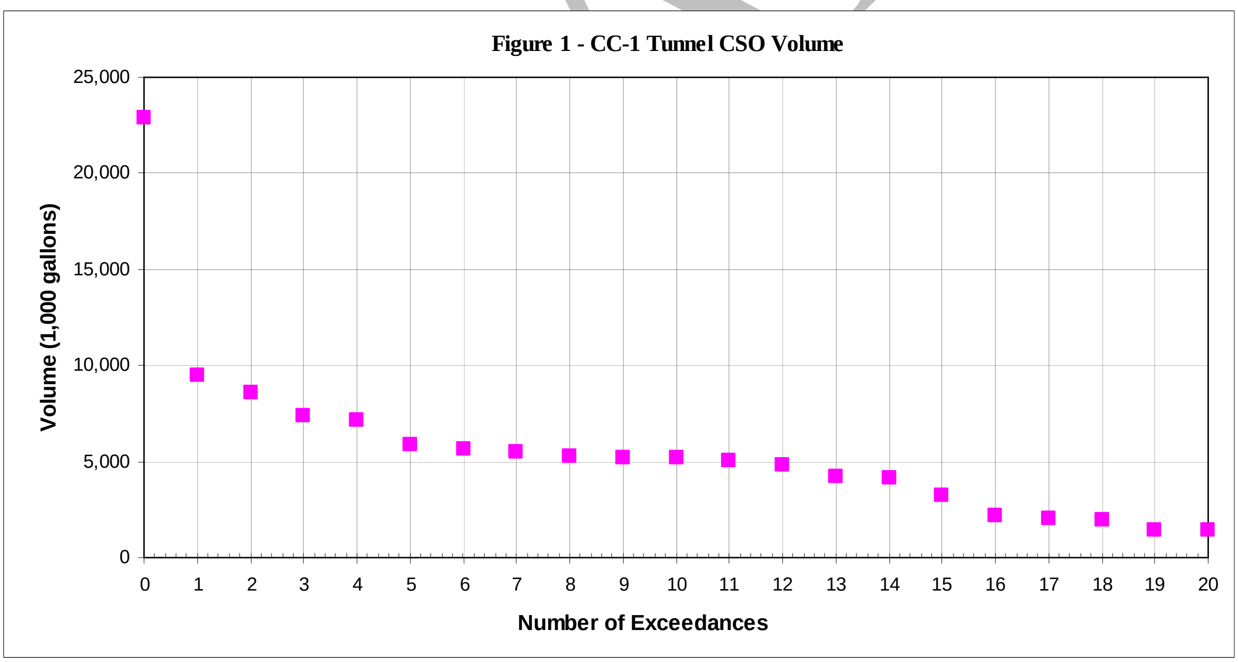


Table 1 – Alternative CC-1 Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year

Baseline Condition simulation, sewershed characteristics, and the CSO control technology for each outfall and/or Region not controlled by the tunnel.

Table 1: Alternative CC-1 Characteristics

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
C-02 to C-13A Region	C-02	570	86	Tunnel CC-1
	C-03			
	C-05			
	C-05A			
	C-07			
	C-11			
	C-12			
	PC-13A			
C-14 to C-15	C-14			
	C-15			
C-25	C-25	348	147	Surface Storage
C-26A to C-29	C-26A	301	119	Screening & Disinfection
	C-27			
	C-28			
	C-29			
Bells Run Region	Bells Run Region (CSO 039E001 to 068H002)	378	87	Sub-Surface Storage

Tunnel CC-1

The Chartiers Tunnel CC-1 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers C-07 to C-14, with consolidation pipes collecting flow from C-15, and C-02 through C-07, and conveying it to the tunnel. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 7 MGD for 4 overflows. Assuming a tunnel length of approximately 2.2 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 11.5 feet.

Other important components of Tunnel CC-1 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 2 – Tunnel CC-1 Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 2: Tunnel CC-1 Consolidation Sewer and Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
CC-1	Near C-07	C-02, C-03, C-05, C-05A, C-07	218.89	1,950	96
CC-2	Near C-11	C-11, C-12, PC-13A	354.22	1,500	120
CC-3	Near C-14	C-14 and C-15	150.58	2,320	90

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM south of C-07. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development;

as well as natural features such as Chartiers Creek. Approximately 1.5 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 2 – Subsystem Alternative CC-1, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

<u>C-26A to C-29 Region</u> portion of Alternative CC-1 will be controlled via implementation of Screening and Disinfection. Screening and Disinfection facilities significantly reduce the quantities of floatables, coarse solids, and pathogens discharged into the receiving waters. Facilities are commonly equipped with a pump station and odor control measures.

<u>Bells Run Region</u> portion of Alternative CC-1 will be controlled via Sub-Surface Storage. Sub-Surface Storage facilities consist of a below grade storage unit, in combination with a screening unit, to temporarily store CSO waters. Stored flows from the facility are slowly reintroduced into the collection and conveyance system after the storm event concludes and the system equalizes. Sub-surface storage methods typically consist of closed concrete tanks, and are also equipped with a pump station and odor control measures.

Details for the CSO volume and peak rates, and the results of the technology scoring and costs for the other outfalls that are not included in the tunnel can be found in the Outfall Specific and the Regional Analysis appendices.

<u>Alternative CC-2</u>

Alternative CC-2 is based upon Tunnel CC-2 having an approximate length of 25,000 feet. *Attachment 3 – Subsystem Alternative CC-2 Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and approximate location of the tunnel. All of the Chartiers Creek and Bells run outfalls are included in this tunnel.

Tunnel CC-2 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 60.87 MG to 10.95 MG for control levels of 0 to 6 overflow events, respectively. *Figure 2 – CC-2 Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

Figure 2 - CC-2 Tunnel CSO Volume

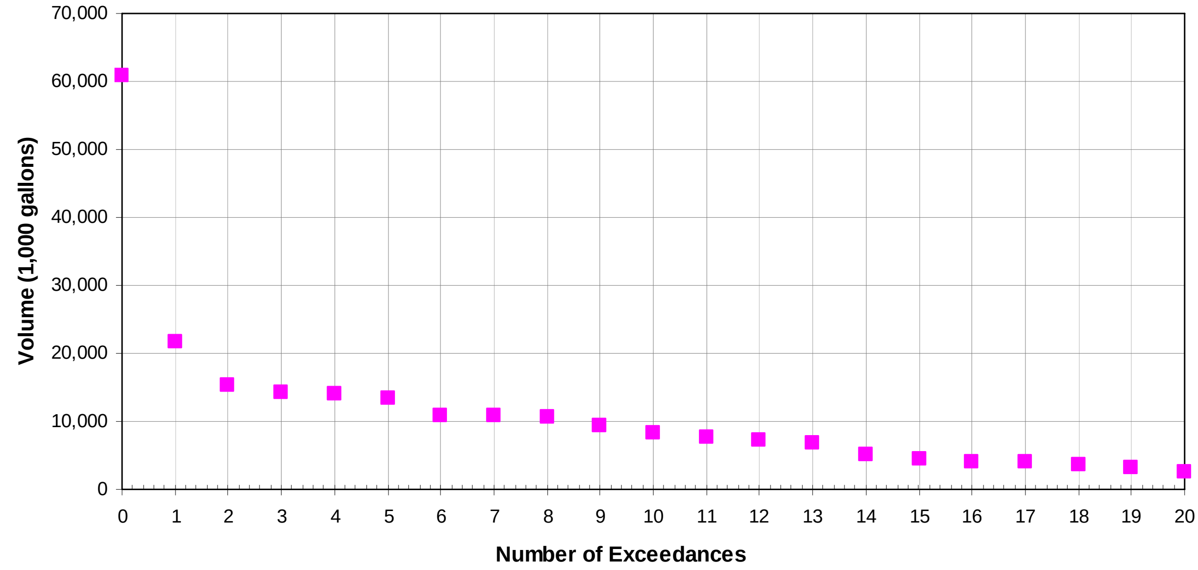


Table 3 – Alternative CC-2 Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation and sewershed characteristics for outfall and/or Region.

Table 3: Alternative CC-2 Characteristics

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
C-2 to PC-13A Region	C-02	1980	92	Tunnel CC-2
	C-03			
	C-05			
	C-05A			
	C-07			
	C-11			
	C-12			
	PC-13A			
C-14 to C-15	C-14			
	C-15			

Alternative Menu

NOTE: All PW Costs are in million $; all capital costs are in $.

GM-1				
CONSOLIDATION SEWERS - Total				
				Capital Costs
Cost (0/yr):				$ 7,881,000
TUNNEL STORAGE (O-8 through O-13)				
RIVER CROSSING #1 - Microtunnel				
	N/A			
RIVER CROSSING #2 - Microtunnel				
	N/A			
RIVER CROSSING #3 - Microtunnel				
	N/A			
RIVER CROSSING #4 - Microtunnel				
	N/A			
REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS				
	Size (MG or MGD)	Recommended Control Technology	PW Costs ($M)	Capital Costs ($)
Size / Cost (4/yr):				

RESULTS SUMMARY		
Number of Events / Year	4	
Number of Overflows / Year	94	
Peak Volume	843,869	CF
	6.31	MG
Total Volume	20,364,787	CF
	152.33	MG
Peak Rate	321.87	CFS
	208.02	MGD

CONSOLIDATION SEWERS - Total		
94 Overflows / Year		
SUBTOTAL CAPITAL COST	**$**	**7,881,000**

TUNNEL STORAGE (O-8 through O-13)			
94 Overflows / Year			
1. Tunnel Parameters			
Tunnel Type (1=Rock; 2=Soft Ground)	1	**Rock**	Typ Rock, Rev as Req'd
Peak Volume (MG / CF)	6.31	844,000	Ref: CSO Statistics
Available Capacity (% Vol)	80%		Ref: Technical Parameters
Required Facility Volume (MG / CF)	7.89	1,055,000	= Peak Vol / Available Capacity
Tunnel Diameter (Ft), 7' to 30' diameter range	15.5		Input by Engineer
Tunnel Volume / Ft length (CF)	188.60		Ref: Tunnel diameter
Tunnel Length (Ft)	5,594		= Req'd Fac Vol / Vol per Ft Length; Target length is 5,387 ft
Drop Shaft Spacing - Default Value = 2,000 ft	2000		Rev as Req'd, Ref: Tech Par
Number of Drop Shafts Included in Tunnel Cost Eqn.	3	2	
Additional Drop Shafts Required (<25 MGD/>25 MDG)	0	0	Input by Engr = # Regs in Reg (TYP)
Construction Cost (Tunnel) $	**19,977,000**		OR = Length/Spacing
2. Dewatering Pump Station / Force Main Parameters			
Volume Requiring Pumping (%)	100%		Ref: Technical Parameters
Dewatering Time (Days)	1		Typ 1, Rev as Req'd Ref: Tech Par
Dewatering Pumping Rate (MGD / CFS)	6.31	9.77	= Peak Tnl Vol/DW Time x % Req Pump
Force Main Diameter (In)	17		DW Pump Rate / 2 FPS
Force Main Velocity (FPS)	6.2	**Check:**	OK - Velocity >2 fps/< 10 fps
Force Main Length (Ft)	100		Input by Engineer
Construction Cost (PS / Force Main) $	**2,388,000**	**$ 25,000**	
3. Consolidation and/or Outfall Pipe Parameters (Tunnel Related)			
Peak Flow (CFS) per Vortex Drop Shaft	160.94		Peak Flow / # drop shaft
Diameter (In)	90		<25cfs=36"; 25-50cfs=48"; 50-100cfs=66"; 100-150cfs=78"; 150-200cfs=90", 200-250cfs=96"; 250-300cfs=108"; >300cfs=120"
Length (Ft)	-		75' per drop shaft
Average Depth (Ft)	-		Input by Engineer
Construction Cost (Consolidation Pipe) $	**-**		Ancillary pipe / Pipe to connect outfalls
4. Odor Control Parameters			
Air Changes / Hour (ACH)	3		Ref: Technical Parameters
Volume of Ventilated Space (CF)	1,583,000		= 1.5 x Volume
Odor Control Flow Rate (CFM)	79,150		= ACH x Volume / 60
Construction Cost (Odor Control) $	**2,814,000**		
5. Screening Parameters			
Screening Required (Yes = 1; No = 2)	1		Screens normally at PS - revise as required; Typ 1, Rev as Req'd, Ref: Tech Par
Peak Flow, into facility (MGD)	6.31		Ref: CSO Statistics
Construction Cost (Screening) $	**705,000**		
6. Stored Volume Treatment			
Volume Requiring Treatment (MG)	6.31		Peak Volume (MG)
Dewatering Time (Days)	2		Typ 2, Rev as Req'd
Dewatering Pumping Rate (MGD)	3.16		= Peak Vol/DW Time
Construction Cost $	**9,532,770**		
7. Regulator Parameters			
Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg; 4=Mod Reg)	2	**Auto Regulator**	New Reg w/ Vortex, Rev as Req'd
Number Regulators	2		Typ = #Vortex Shaft, Rev as Req'd
Construction Cost (Regulators/Vortex) $	**2,570,000**		
8. Land Acquisition Parameters			
Land Required - Drop Shafts (SF)	5,000		2,500 SF / Shaft
Land Required - Dewatering PS (SF)	1,578		250 SF / MGD
Land Required - Odor Control (SF)	3,958		500 SF / 10,000 CFM
Land Required - Screening (SF)	1,578		250 SF / MGD
Land Required - Regulator (SF)	20,000		Ref: 10,000 SF / Regulator
Land Required - Total (SF)	*32,000*		
Land Required Cost (/ SF)	$ 2		Ref: Technical Parameters
Land Acquisition Cost $	**64,000**		
		SUBTOTAL CAPITAL COST $	**38,075,770**

RIVER CROSSING #1 - Microtunnel - N/A			
94 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
	SUBTOTAL CAPITAL COST		**$ -**

RIVER CROSSING #2 - Microtunnel - N/A			
94 Overflows / Year			
Peak Flow (CFS) - N/A	-	-	Ref: Technical Parameters
Diameter (In)	36	36	Ref: Technical Parameters
Length - Open Cut (Ft)	-	-	Input by Engineer
Depth - Open Cut (Ft)	-	-	Input by Engineer
Length - Microtunnel (Ft)	-	-	Input by Engineer
No. of Interceptor Connections Req'd	-	-	Input by Engineer
Construction Cost (Interceptor Connections)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Open Cut)	**$ -**	**$ -**	Ref: Cost Curves
Construction Cost (Microtunnel)	**$ -**	**$ -**	Ref: Cost Curves
	SUBTOTAL CAPITAL COST		**$ -**

REGIONAL and/or OUTFALL SPECIFIC SOLUTIONS			
94 Overflows / Year			
1.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
2.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
3.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
4.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
5.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
6.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
7.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
8.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
9.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
10.			
0	-	-	Size & Cost by Engineer (from Regional Alts)
	SUBTOTAL CAPITAL COST	**$**	**-**

TOTAL CAPITAL COST $ 45,956,770

Storage Technologies: Annual O&M Cost Calculations (4 Overflows / Year)

CONSOLIDATION SEWERS - Total

TUNNEL STORAGE (O-8 through O-13)

0	Requirement	Input Parameter	Input Value	Annual O&M Cost	Service Life (Yr)	Present Worth Factor	Present Worth
Tunnel Storage Compone	Pump Station O&M	Flow Rate (MGD)	6.31	$64,370	20	10.910	$702,278
	Tunnel Maintenance	Length (ft)	5594	$1,790	50	14.484	$25,927
		Cost / 8-man Crew ($)	$1,600				
	Shaft Maintenance	No. Shafts	2	$156,033	50	14.484	$2,259,918
	Screening O&M	Flow Rate (MGD)	6.31	$7,966	20	10.910	$86,909
	Odor Control O&M	Capacity (CFM)	79,150	$277,025	20	10.910	$3,022,326
	Reserve / Replace	10% Gravity / 15% Pump					$19,315
			Subtotal Annual O&M	**$508,000**		**Subtotal PW O&M**	**$6,117,000**

Subsystem Components

TOTAL ANNUAL O&M	**$508,000**
ANNUAL O&M ($MM)	**$0.51**

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	GM-1
Structures within Region	#N/A
Model ID	GM-1.1
Structure Type	
PWSA Sewershed	
Stream of Discharge	
NPDES Permit Number	
Owner	
Model Network	(07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run	2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Results Summary

Number of Events:	94	
Peak Volume:	3,633,204	ft^3
	27.18	MG
Total Volume:	20,364,787	ft^3
	152.34	MG
Peak Rate:	606.41	cfs

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
1/5/2005 0:18	3342	1/5/2005 14:45	3633203.78	27178.181	0	81.73	21
1/11/2005 7:31	1697	1/12/2005 1:30	1034355.27	7737.495	1	71.12	26
10/24/2005 12:46	1817	10/25/2005 2:15	958100.83	7167.073	2	45.63	34
11/14/2005 21:30	590	11/15/2005 3:45	880168.30	6584.099	3	160.00	9
7/5/2005 16:00	139	7/5/2005 16:30	843868.91	6312.561	4	606.41	0
2/14/2005 4:16	1226	2/14/2005 10:00	813609.29	6086.204	5	25.81	49
11/29/2005 1:45	754	11/29/2005 11:15	748652.95	5600.298	6	74.44	25
6/11/2005 17:30	60	6/11/2005 18:00	736639.22	5510.430	7	461.99	1
8/20/2005 18:00	114	8/20/2005 19:00	712584.15	5330.486	8	357.76	3
1/3/2005 3:21	1295	1/3/2005 13:50	633008.20	4735.218	9	36.53	41
7/12/2005 18:45	125	7/12/2005 20:00	625575.10	4679.615	10	321.87	4
5/13/2005 22:30	690	5/13/2005 23:45	619263.29	4632.399	11	130.24	13
4/1/2005 19:15	1182	4/2/2005 6:30	519919.18	3889.255	12	64.03	30
4/23/2005 3:15	550	4/23/2005 3:45	430829.76	3222.822	13	142.81	11
3/28/2005 7:55	789	3/28/2005 10:15	427570.57	3198.442	14	36.40	43
7/15/2005 17:30	90	7/15/2005 18:00	425525.14	3183.141	15	187.74	8
5/14/2005 16:00	410	5/14/2005 16:15	421407.74	3152.341	16	440.30	2
9/29/2005 5:00	124	9/29/2005 5:45	392621.04	2937.002	17	309.74	5
1/13/2005 22:35	304	1/14/2005 2:05	338980.61	2535.744	18	39.47	37
7/26/2005 19:30	65	7/26/2005 20:00	329754.60	2466.729	19	271.99	7
8/29/2005 9:15	394	8/29/2005 13:00	319921.82	2393.175	20	119.88	16
1/8/2005 1:00	597	1/8/2005 5:15	317128.11	2372.277	21	79.22	22
3/23/2005 2:30	715	3/23/2005 12:30	268587.01	2009.165	22	37.01	40
5/11/2005 22:30	120	5/11/2005 22:45	266479.32	1993.399	23	99.07	19
5/28/2005 8:15	634	5/28/2005 9:15	262098.96	1960.631	24	65.54	29
12/15/2005 10:45	589	12/15/2005 14:00	247956.34	1854.837	25	92.89	20
5/23/2005 16:15	50	5/23/2005 16:30	233259.68	1744.899	26	287.83	6
10/21/2005 18:33	221	10/21/2005 19:10	178723.70	1336.943	27	36.41	42
11/9/2005 19:15	50	11/9/2005 19:30	174344.33	1304.183	28	149.60	10
2/9/2005 14:50	145	2/9/2005 16:45	166157.31	1242.940	29	75.80	23
7/17/2005 16:00	60	7/17/2005 16:15	165464.92	1237.760	30	122.34	14
2/20/2005 15:25	699	2/20/2005 20:00	162968.22	1219.084	31	69.26	27
10/7/2005 7:05	390	10/7/2005 10:45	161658.80	1209.289	32	44.83	35

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
7/21/2005 14:15	55	7/21/2005 14:45	143466.50	1073.201	33	140.06	12
10/22/2005 6:55	694	10/22/2005 16:45	140081.25	1047.878	34	30.54	45
4/22/2005 15:45	329	4/22/2005 16:15	138779.34	1038.139	35	43.25	36
4/20/2005 18:30	349	4/20/2005 21:30	127642.21	954.828	36	37.31	39
5/20/2005 3:00	529	5/20/2005 6:30	126387.88	945.445	37	29.99	46
9/26/2005 6:45	317	9/26/2005 8:00	124386.63	930.474	38	68.61	28
7/25/2005 13:00	55	7/25/2005 13:30	122746.86	918.208	39	121.94	15
11/1/2005 14:31	218	11/1/2005 16:30	107641.57	805.213	40	24.80	50
4/30/2005 4:16	169	4/30/2005 6:45	99241.68	742.377	41	26.05	48
3/24/2005 9:30	40	3/24/2005 9:45	80677.70	603.510	42	107.19	17
6/14/2005 18:45	75	6/14/2005 19:30	74263.84	555.531	43	35.62	44
11/16/2005 4:00	454	11/16/2005 4:15	61476.61	459.876	44	61.53	31
6/28/2005 18:00	70	6/28/2005 18:15	60233.57	450.577	45	75.73	24
8/27/2005 15:04	50	8/27/2005 15:30	59398.25	444.329	46	101.24	18
2/16/2005 7:00	99	2/16/2005 7:20	59168.79	442.612	47	21.43	53
11/9/2005 4:00	95	11/9/2005 4:30	53745.84	402.046	48	48.41	32
8/26/2005 20:45	55	8/26/2005 21:00	52574.55	393.284	49	46.40	33
12/25/2005 10:40	169	12/25/2005 13:00	48200.35	360.563	50	22.46	52
3/27/2005 16:45	93	3/27/2005 17:15	41972.09	313.972	51	22.90	51
6/3/2005 7:47	108	6/3/2005 9:15	25596.26	191.473	52	27.81	47
5/7/2005 12:01	108	5/7/2005 13:30	24387.35	182.430	53	38.20	38
3/20/2005 3:31	303	3/20/2005 7:25	23461.20	175.501	54	18.29	55
6/10/2005 21:15	40	6/10/2005 21:35	17512.11	130.999	55	19.48	54
4/3/2005 1:00	421	4/3/2005 4:45	16764.83	125.409	56	8.21	57
3/7/2005 22:10	368	3/8/2005 1:45	14140.43	105.778	57	4.00	63
8/8/2005 8:32	57	8/8/2005 9:05	11734.48	87.780	58	15.45	56
4/27/2005 0:15	105	4/27/2005 0:40	10272.61	76.844	59	7.44	58
12/31/2005 23:00	60	12/31/2005 23:05	8201.28	61.350	60	2.39	67
1/30/2005 1:16	654	1/30/2005 11:40	7774.45	58.157	61	4.00	64
11/6/2005 13:45	35	11/6/2005 14:10	4380.88	32.771	62	5.82	60
11/23/2005 19:25	64	11/23/2005 20:20	3942.78	29.494	63	6.63	59
8/16/2005 5:02	122	8/16/2005 6:40	2341.49	17.516	64	1.97	68
10/21/2005 7:18	42	10/21/2005 7:45	2250.42	16.834	65	3.06	65
11/24/2005 7:55	234	11/24/2005 8:15	2090.53	15.638	66	1.17	73
7/17/2005 8:45	20	7/17/2005 9:00	2085.56	15.601	67	5.18	61
9/16/2005 8:45	34	9/16/2005 9:00	2074.01	15.515	68	4.27	62
10/24/2005 1:42	112	10/24/2005 3:25	1726.26	12.913	69	1.61	70
5/24/2005 21:05	30	5/24/2005 21:15	1668.84	12.484	70	1.55	71
7/13/2005 15:45	20	7/13/2005 16:00	1633.10	12.216	71	2.61	66
2/25/2005 13:05	44	2/25/2005 13:15	1072.56	8.023	72	0.74	74
7/27/2005 3:16	18	7/27/2005 3:30	918.11	6.868	73	1.87	69
6/17/2005 1:25	69	6/17/2005 1:30	797.32	5.964	74	1.42	72
3/11/2005 13:30	34	3/11/2005 14:00	553.58	4.141	75	0.33	82
8/5/2005 11:05	29	8/5/2005 11:25	549.90	4.114	76	0.50	77
10/26/2005 8:41	113	10/26/2005 10:30	517.42	3.871	77	0.59	76
2/8/2005 5:45	94	2/8/2005 7:15	516.68	3.865	78	0.35	80
6/16/2005 11:16	333	6/16/2005 16:45	476.66	3.566	79	0.62	75
1/26/2005 7:50	74	1/26/2005 9:00	426.98	3.194	80	0.32	83
3/12/2005 11:30	19	3/12/2005 11:45	319.31	2.389	81	0.36	78
1/22/2005 10:16	63	1/22/2005 10:30	317.27	2.373	82	0.26	85
2/24/2005 19:00	19	2/24/2005 19:15	301.64	2.256	83	0.35	79
12/26/2005 6:00	19	12/26/2005 6:15	301.14	2.253	84	0.34	81
2/26/2005 13:03	61	2/26/2005 14:00	198.00	1.481	85	0.13	91
5/19/2005 19:30	19	5/19/2005 19:45	188.28	1.408	86	0.21	88

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
12/4/2005 6:30	18	12/4/2005 6:45	175.10	1.310	87	0.20	89

Exceedance Summary

Exceedance Timing			Exceedance Volume			Peak Flow Rate	
Start of Exceedance	Exceedance Duration (minutes)	Time of Peak Flow	(ft^3)	(1,000 gallons)	Number of Exceedances	(cfs)	Number of Exceedances
4/24/2005 23:46	18	4/25/2005 0:00	172.51	1.290	88	0.22	86
9/23/2005 2:30	18	9/23/2005 2:45	172.42	1.290	89	0.19	90
4/25/2005 6:06	13	4/25/2005 6:15	129.87	0.971	90	0.30	84
4/24/2005 4:06	13	4/24/2005 4:15	103.54	0.775	91	0.22	87
5/27/2005 20:32	14	5/27/2005 20:40	43.26	0.324	92	0.05	92
4/24/2005 14:53	9	4/24/2005 15:00	25.05	0.187	93	0.05	93

Region 1

PWSA CSO DISCHARGES
for "Typical Year - 2005"
Base Line Condition

Region Name	GM-1	**Results Summary**		
Structures within Region	#N/A	Number of Events:	94	
Model ID	GM-1.1	Peak Volume:	3,633,204	ft^3
Structure Type			27.18	MG
PWSA Sewershed		Total Volume:	20,364,787	ft^3
Stream of Discharge			152.34	MG
NPDES Permit Number		Peak Rate:	606.41	cfs
Owner				

Model Network (07/19/07) Baseline Conditions#2 - FINAL!#1_1#2
Model Run 2005 Baseline Conditions w/Boundary (8.8.07) - Systemwide Selection

Figure 1 - GM-1 Region CSO Volume

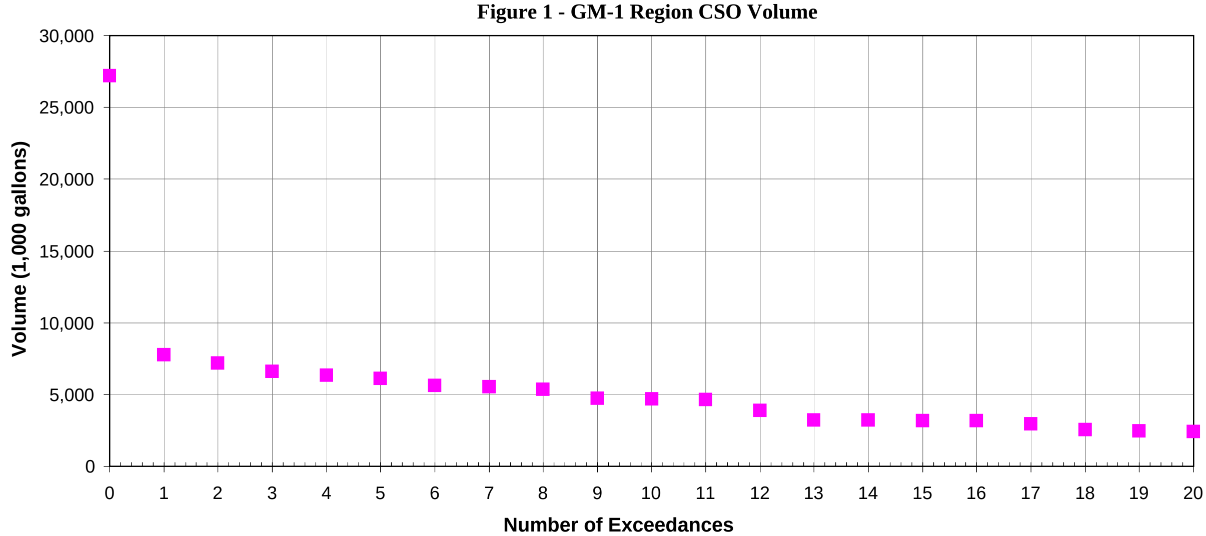
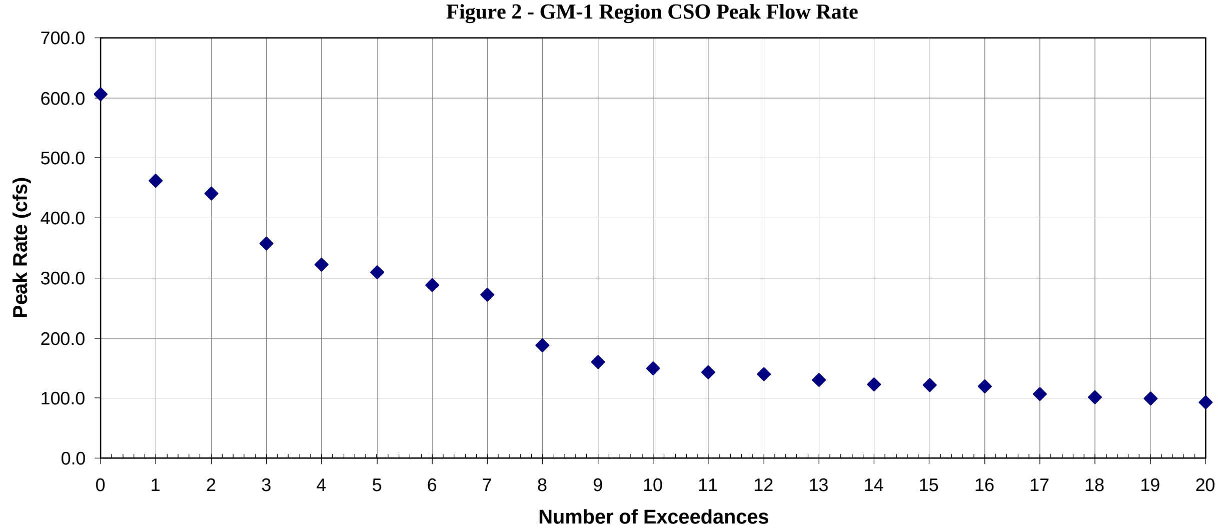


Figure 2 - GM-1 Region CSO Peak Flow Rate



Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
C-25	C-25			
C-26A to C-29	C-26A			
	C-27			
	C-28			
	C-29			
Bells Run Region	Bells Run Region (CSO 039E001 to 068H002)			

Tunnel CC-2

The Chartiers Tunnel CC-2 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers C-2 to C-19 and then follows the interceptor to a sharp bend in Chartiers Creek near Crafton Avenue. The tunnel then deviates from the path of the interceptor to go straight southwest to ALCOSAN diversion chamber C-25 where the tunnel ends. Flow from the Bells Run overflows (CSO 039E001, CSO 039J001, CSO 039K001, CSO 068H001, and CSO 068H002) are collected in a collector pipe that joins the tunnel at the bend in Chartiers Creek near Crafton Avenue. Flow from ALCOSAN diversion chambers C-26A, C-27, C-28, and C-29 is collected in a collector pipe that connects to the tunnel at C-25. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 14 MGD for 4 overflows. Assuming a Tunnel length of approximately 4.7 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 11 feet.

Other important components of Tunnel CC-2 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 4 – Tunnel CC-2 Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 4: Tunnel CC-2 Consolidation Sewer and Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
CC-1	Near C-07	C-02, C-03, C-05, C-05A, C-07	218.89	1,950	96
CC-2	Near C-11	C-11, C-12, PC-13A	354.22	1,500	120
CC-3	Near C-14	C-14, C-15	150.58	2,320	90
CC-4	Intersection of tunnel and Bells Run collector pipe	CSO 039E001 CSO 039J001 CSO 039K001 CSO 068H001 CSO 068H002	196.48	9,885	90
CC-5	Near C-25	C-25, C-26A, C-27, C-28, C-29	95.74	3,945	66

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM south of C-07. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development; as well as natural features such as Chartiers Creek. Approximately 3 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 4 – Subsystem Alternative CC-2, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

Alternative CC-3

Alternative CC-3 is based upon Tunnel CC-3 having an approximate length of 25,000 feet. *Attachment 5 – Subsystem Alternative CC-3 Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and approximate location of the tunnel. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. This alternative also includes flow from the Glen Mawr overflows. The Project team determined that it may be more cost effective to consolidate flow from the Glen Mawr overflows and convey them to the tunnel serving Chartiers Creek rather than building a separate tunnel for the Glen Mawr overflows.

Tunnel CC-3 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 95.06 MG to 17.32 MG for control levels of 0 to 6 overflow events, respectively. *Figure 3 – CC-3 Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

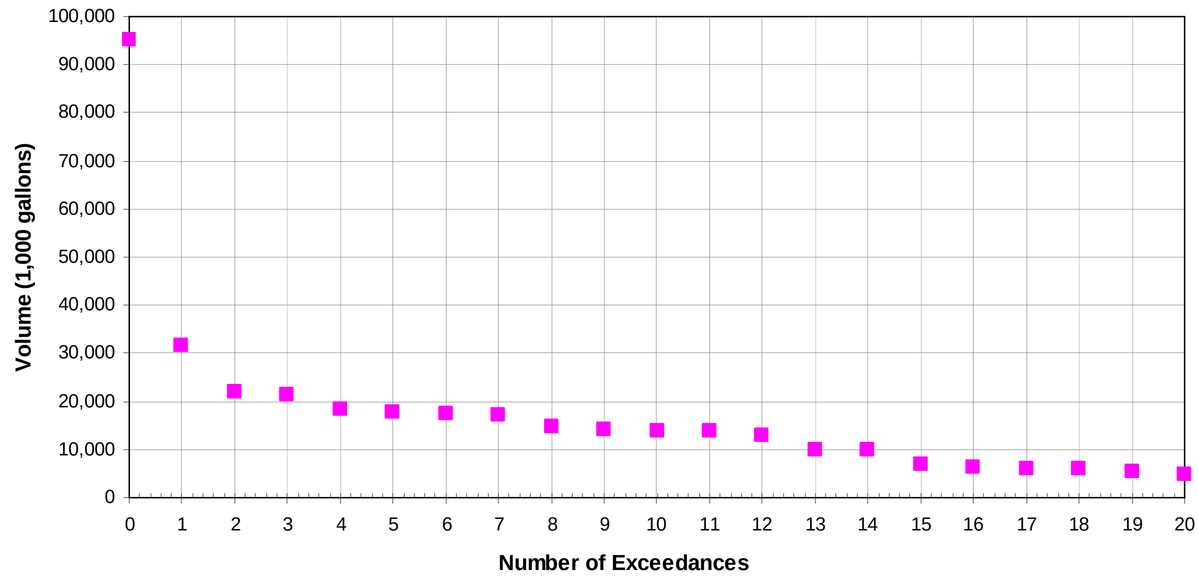


Figure 3 - CC-3 Tunnel CSO Volume

Table 5 – Alternative CC-3 Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation and sewershed characteristics for each outfall and/or Region.

Table 5: Alternative CC-3 Characteristics

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
C-2 to PC-13A Region	C-02	2786	93	Tunnel CC-3
	C-03			
	C-05			
	C-05A			
	C-07			
	C-11			
	C-12			
	PC-13A			
C-14 to C-15	C-14			
	C-15			
C-25	C-25			
C-26A to C-29	C-26A			
	C-27			

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
	C-28			
	C-29			
Bells Run Region	Bells Run Region (CSO 039E001 to 068H002)			
O-8 to O-13 Region	O-08			
	O-09			
	O-10			
	O-11			
	O-13			

Tunnel CC-3

The Chartiers Tunnel CC-3 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers C-2 to C-19 and then follows the interceptor to a sharp bend in Chartiers Creek near Crafton Avenue. Flow from CSO structures O-08, O-09, O-10, O-11, O-13 are collected in a collector pipe that joins the tunnel near C-07. The tunnel then deviates from the path of the interceptor to go straight southwest to ALCOSAN diversion chamber C-25 where the tunnel ends. Flow from the Bells Run overflows (CSO 039E001, CSO 039J001, CSO 039K001, CSO 068H001, and CSO 068H002) are collected in a collector pipe that joins the tunnel at the bend in Chartiers Creek near Crafton Avenue. Flow from ALCOSAN diversion chambers C-26A, C-27, C-28, and C-29 is collected in a collector pipe that connects to the tunnel at C-25. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 18 MGD for 4 overflows. Assuming a Tunnel length of approximately 4.7 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level would be 12.5 feet.

Other important components of Tunnel CC-3 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 6 – Tunnel CC-3 Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 6: Tunnel CC-3 Consolidation Sewer and Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
CC-1	Near C-07	C-02, C-03, C-05, C-05A, C-07	218.89	1,950	96
CC-2	Near C-11	C-11, C-12, PC-13A	354.22	1,500	120
CC-3	Near C-14	C-14, C-15	150.22	2,320	90
CC-4	Intersection of tunnel and Bells Run collector pipe	CSO 039E001 CSO 039J001 CSO 039K001 CSO 068H001 CSO 068H002	196.48	9,885	90
CC-5	Near C-25	C-25, C-26A, C-27, C-28, C-29	95.74	3,945	66
CC-6	Near C-07	O-08, O-09, O-10, O-11, O-13	606.41	6960	120

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM south of C-07. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development; as well as natural features such as Chartiers Creek. Approximately 3.9 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 6 – Subsystem Alternative CC-3, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

Alternative Evaluation Results

Table 7 – Chartiers Creek Subsystem Alternative Costs, illustrates the planning level capital, O&M and present worth costs associated with alternatives CC-1, CC-2, and CC-3 when sized for 4 untreated overflows per year.

Table 7: Glen Mawr Subsystem Alternative Costs

Subsystem	Capital Cost (MM$)	Annual O&M Cost (MM$)	PW Cost (MM$)
CC-1	113.8	1.3	127.7
CC-2	134.5	0.9	145.1
CC-3	169.9	1.1	182.8

For the purpose of this Feasibility Study, the above alternatives were further evaluated based on a combination of their economic, environmental, implementation, and operational impacts over a range of CSO control levels corresponding to 4 untreated overflows per year.

Attachment 7 – Chartiers Creek Subsystem Alternatives Scoring Sheet illustrates the composite scoring of economic, environmental, implementation, an operational evaluation factors for a control level of 4 overflows per year for Alternatives CC-1 and CC-2. Because Alternative CC-3 includes the Glen Mawr overflows, it was not directly compared to the other alternatives, and therefore, does not appear in this figure. As shown on Attachment 7, CC-s was the highest ranked alternative of Alternatives CC-1 and CC-2. Therefore the cost of CC-2 combined with the Alternative GM-1 (see report F.6 for details of this alternative), was selected to be compared against the cost of CC-3. Alternative CC-3 was the lower cost of these two options. Complete details of the economic evaluation and the composite scoring of economic, environmental, implementation and operational evaluation factors can be found in Appendix F.

<u>Recommendations</u>

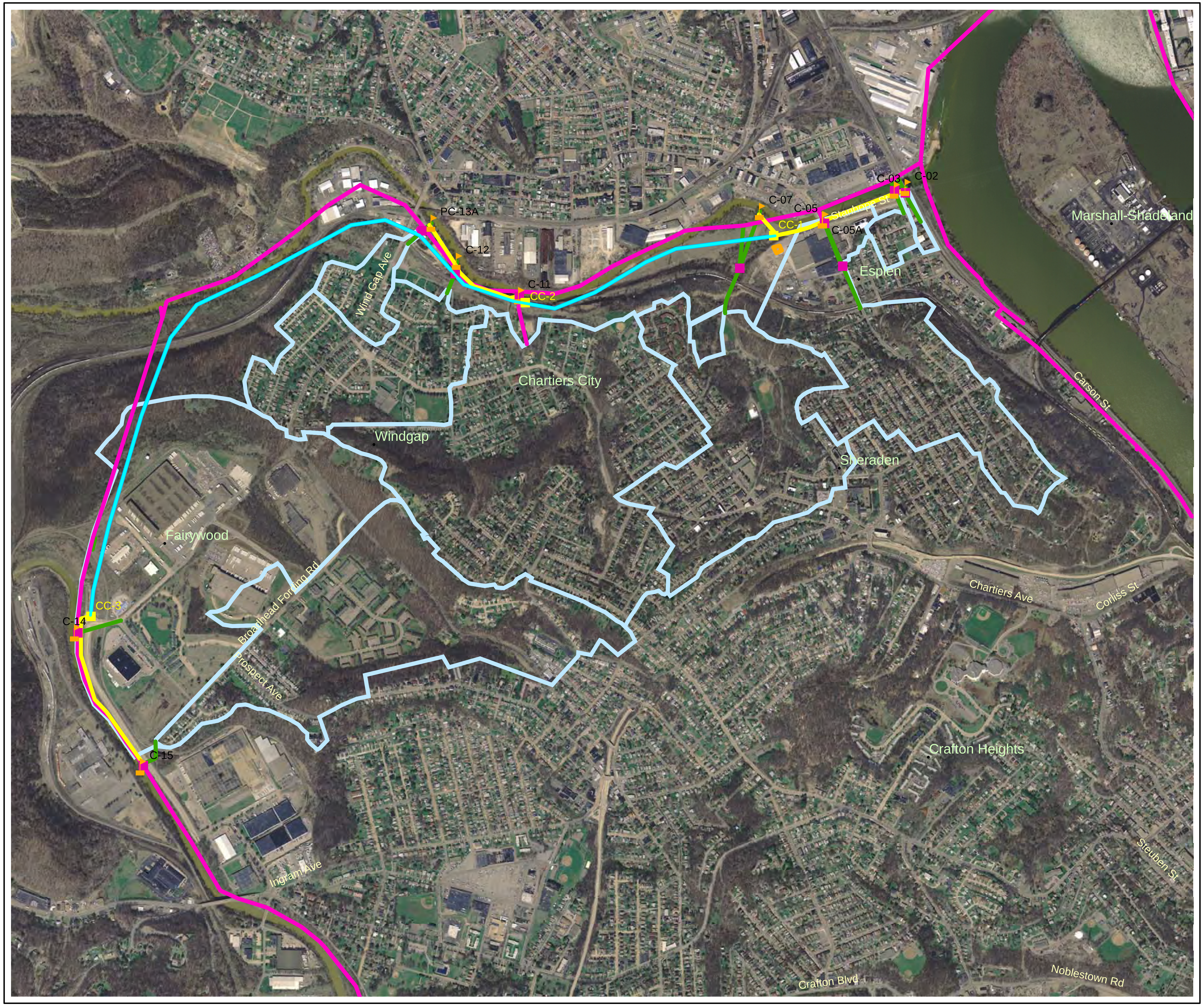
It is recommended that the following alternative be carried forward as part of the overall System-Wide alternative

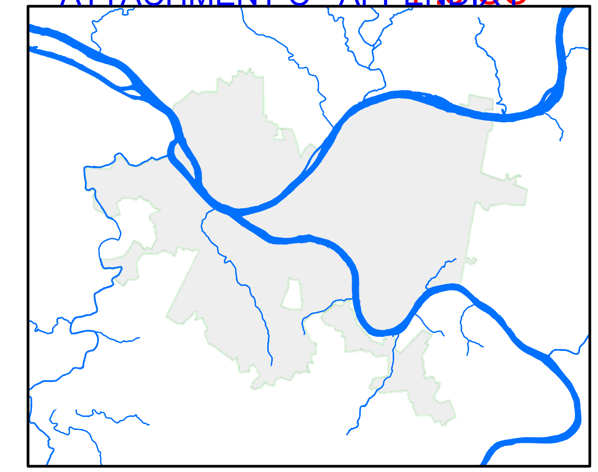
- CC-3: This alternative resulted in the lowest cost alternative when compared to the combined highest ranked Chartiers Creek and Glen Mawr subsystem alternatives for control level of 4 events per year.

Significant Issues

Some issues exist with the siting of a tunnel. It appears that there is some space for the facilities associated with the tunnel, however, there is significant infrastructure at the confluence of Chartiers Creek and the Ohio River. Detailed geotechnical studies would have to be completed to determine the suitability of the underlying subsurface conditions for tunnel construction. In addition, construction of drop shafts and the consolidation sewers will be a significant endeavor considering the congested infrastructure and natural features that exist in the area where the sewers would be constructed. In addition to the geotechnical studies, permitting, and land acquisition would determine the final location of these facilities if this alternative is selected for implementation. Any potential issues associated with the outlier outfalls are presented in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

ATTACHMENT C - APPENDIX F E5CC





Legend

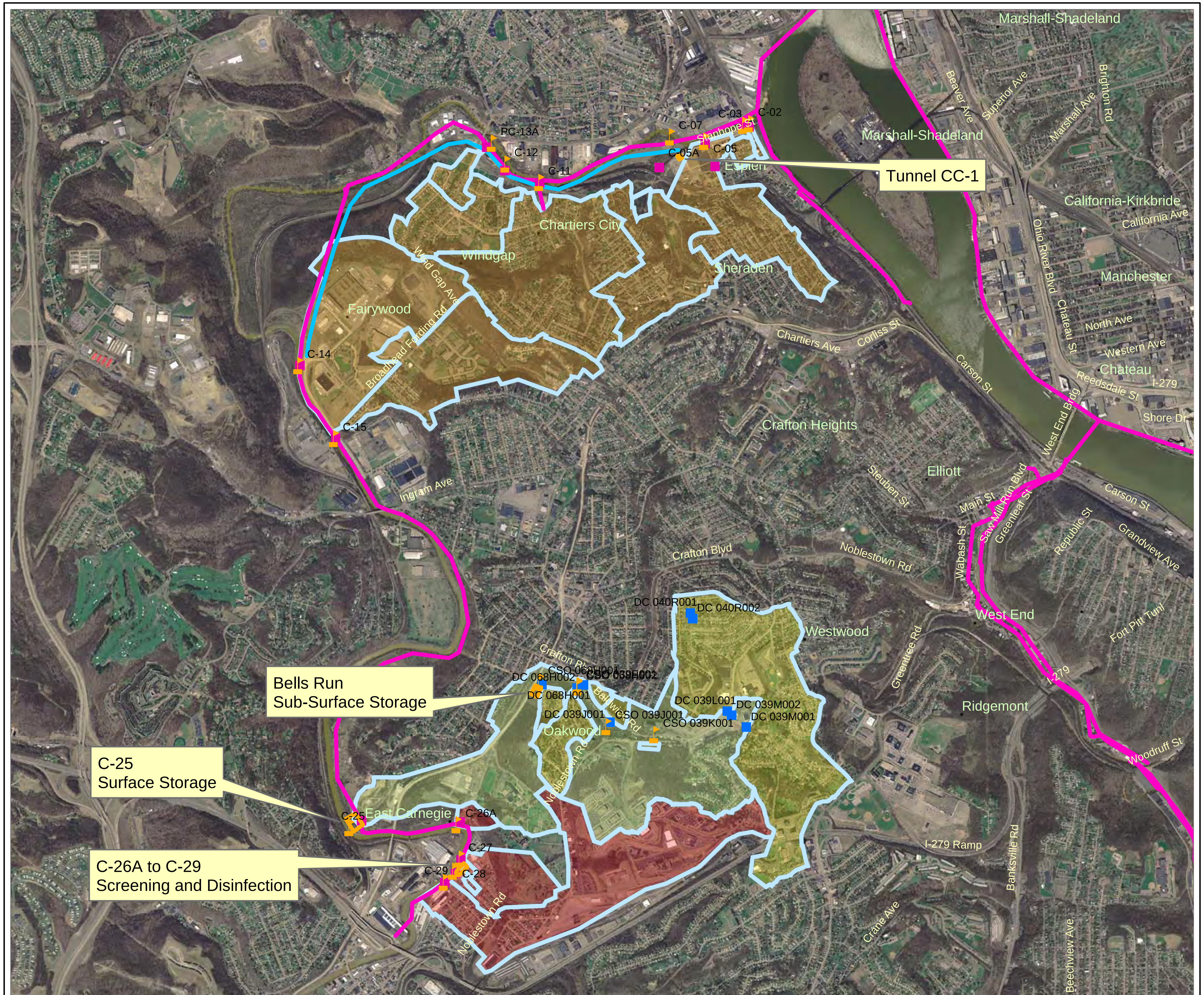
- Sewershed Boundary
- Facility Boundary
- Tunnel CC-1
- Consolidation Pipe
- ALCOSAN Interceptor
- Trunk Sewer
- ALCOSAN Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

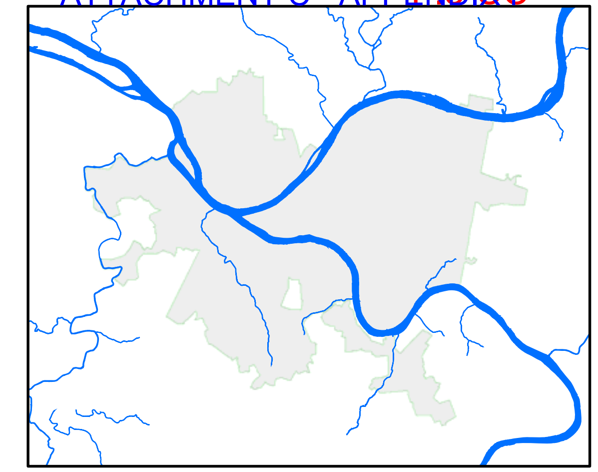
1,000 0 1,000
Feet

Attachment 1 Subsystem Alternative CC-1 Tunnel Portion

CSO Controls Alternatives

PWSA THE PITTSBURGH WATER & SEWER AUTHORITY Quality Water Quality Service





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Sub-Surface Storage
- Surface Storage
- Screening and Disinfection
- Tunnel CC-1
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Combined Sewer Outfall

2,000 0 2,000 Feet

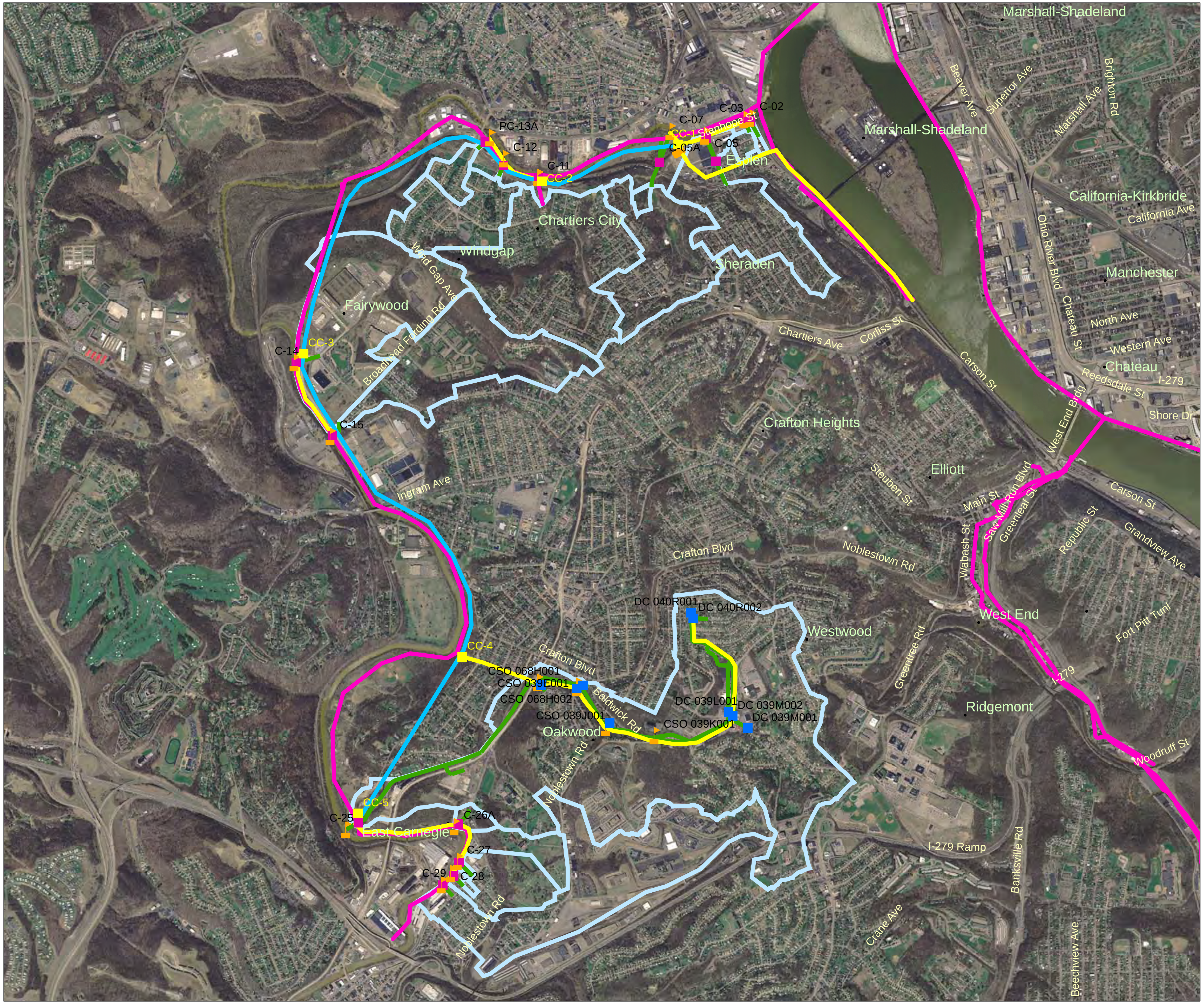
Attachment 2 Subsystem Alternative CC-1

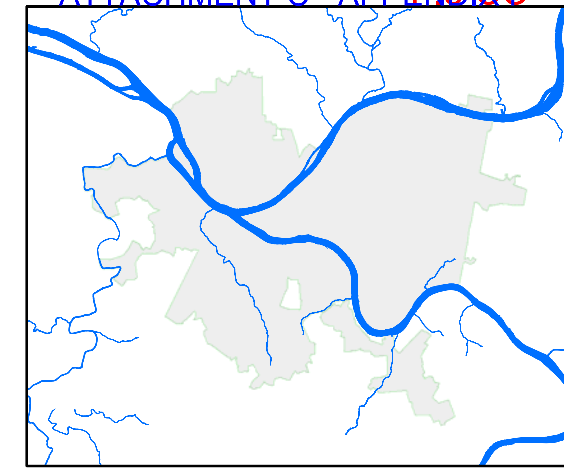
CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

ATTACHMENT C - APPENDIX G

E5 CC





Legend

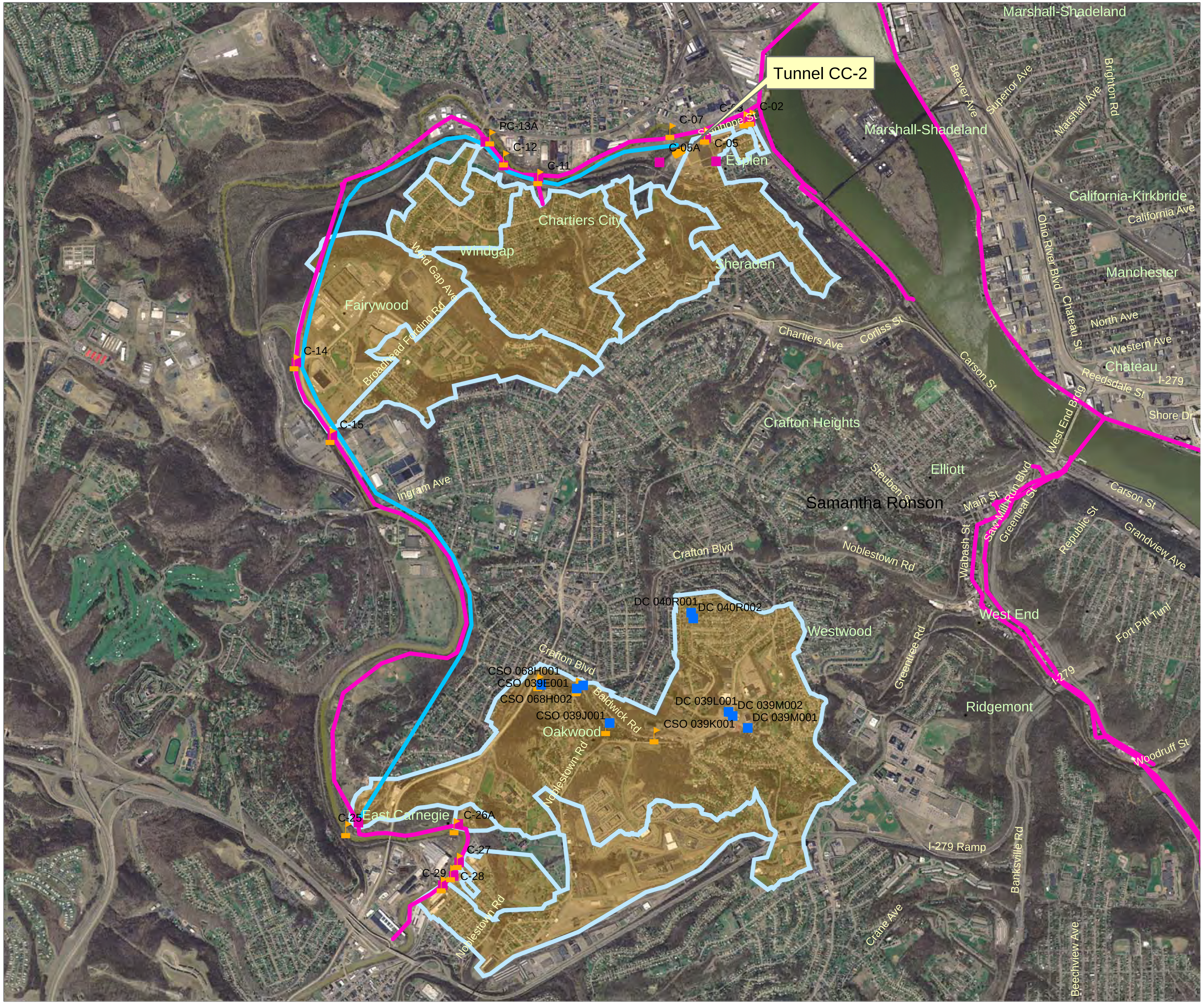
- Sewershed Boundary
- Facility Boundary
- Tunnel CC-2
- Consolidation Pipe
- ALCOSAN Interceptor
- Trunk Sewer
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

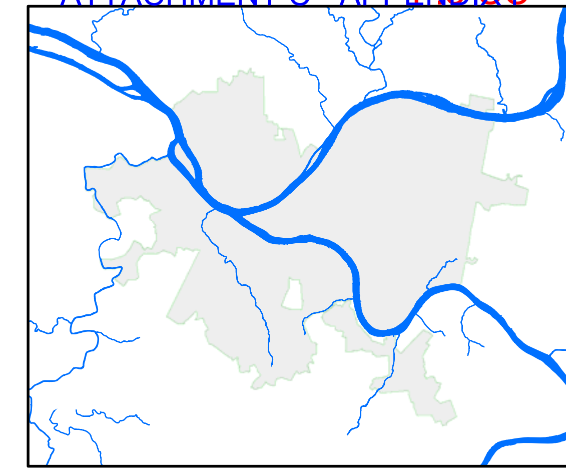
2,000 0 2,000 Feet

Attachment 3 Subsystem Alternative CC-2 Tunnel Portion

CSO Controls Alternatives

PWSA THE PITTSBURGH WATER & SEWER AUTHORITY Quality Water Quality Service





Legend

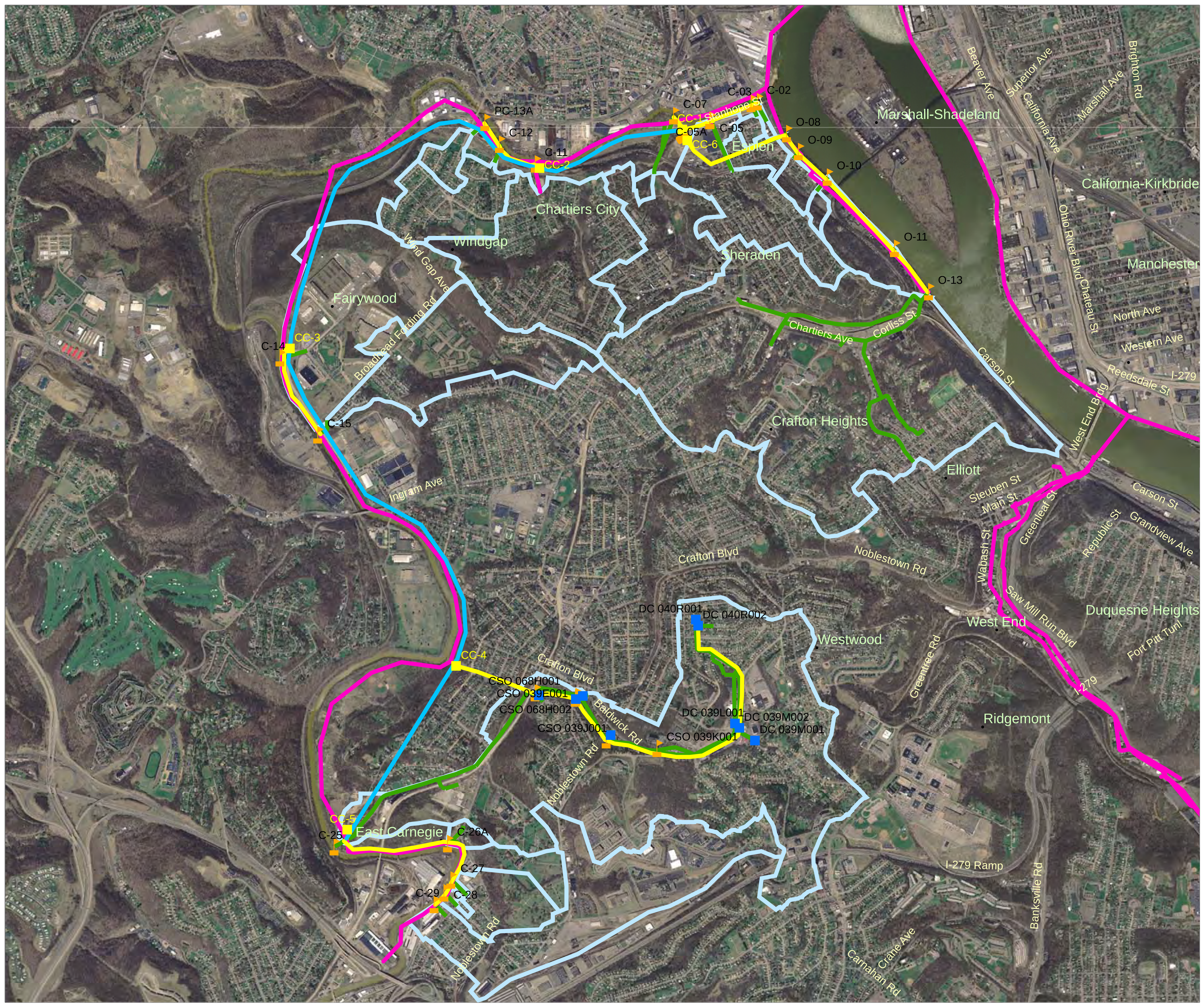
- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Tunnel CC-2
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Combined Sewer Outfall

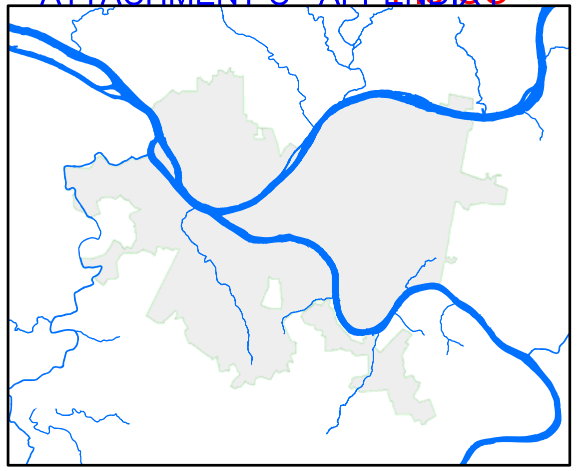
2,000 0 2,000 Feet

Attachment 4 Subsystem Alternative CC-2

CSO Controls Alternatives

PWSA THE PITTSBURGH WATER & SEWER AUTHORITY Quality Water Quality Service





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel CC-3
- Consolidation Pipe
- ALCOSAN Interceptor
- Trunk Sewer
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

2,000 0 2,000
Feet

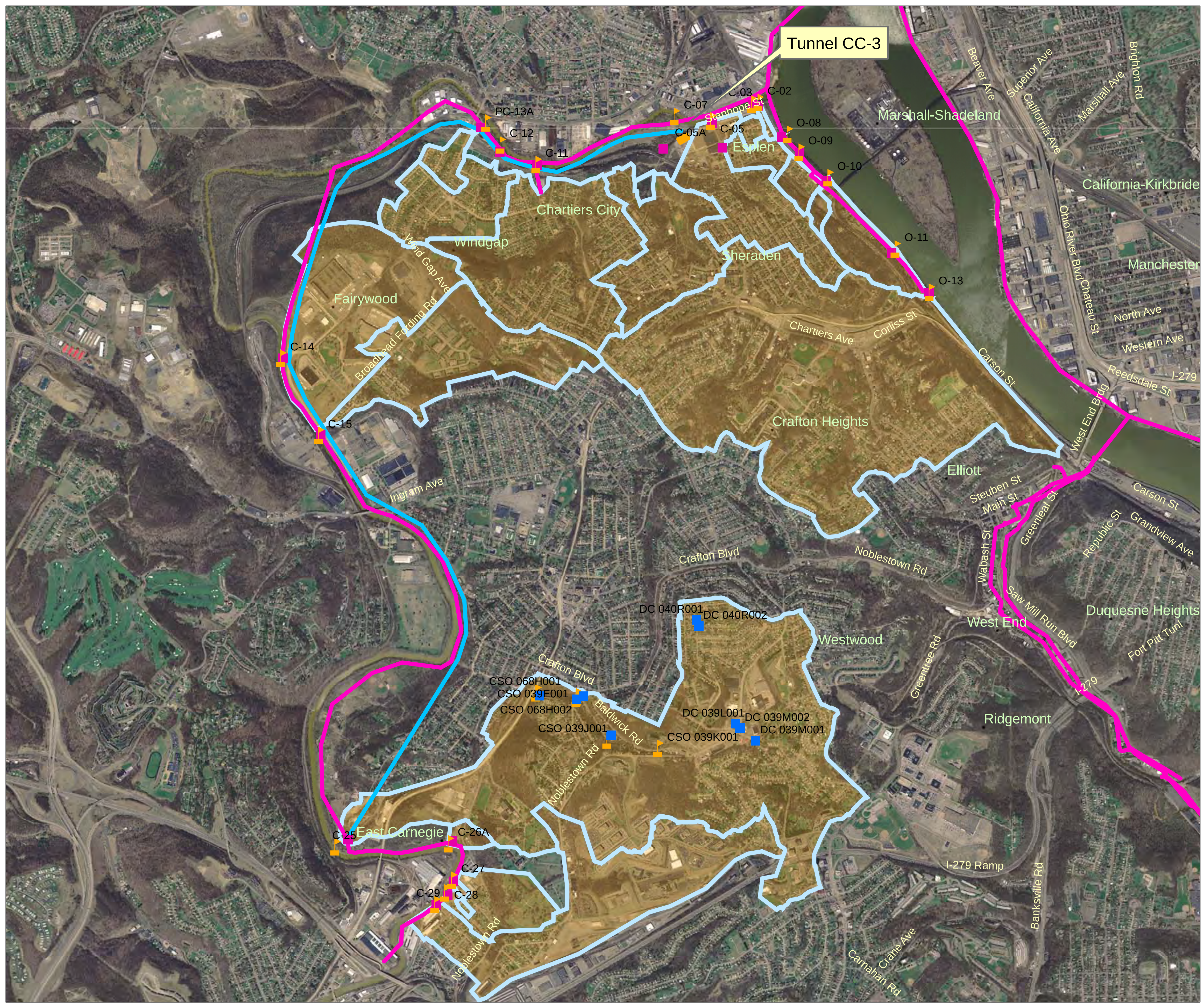
Attachment 5 Subsystem Alternative CC-3 Tunnel Portion

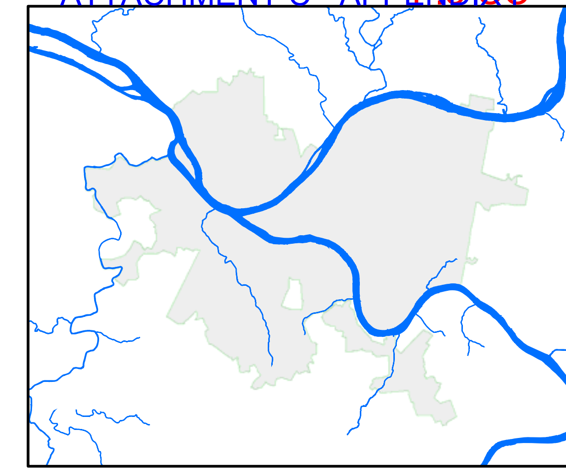
CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

ATTACHMENT C - APPENDIX G

E5.CC





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Tunnel CC-3
- Consolidation Pipe
- ALCOSAN Interceptor
- Trunk Sewer
- ALCOSAN Diversion Structure
- PWSA Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

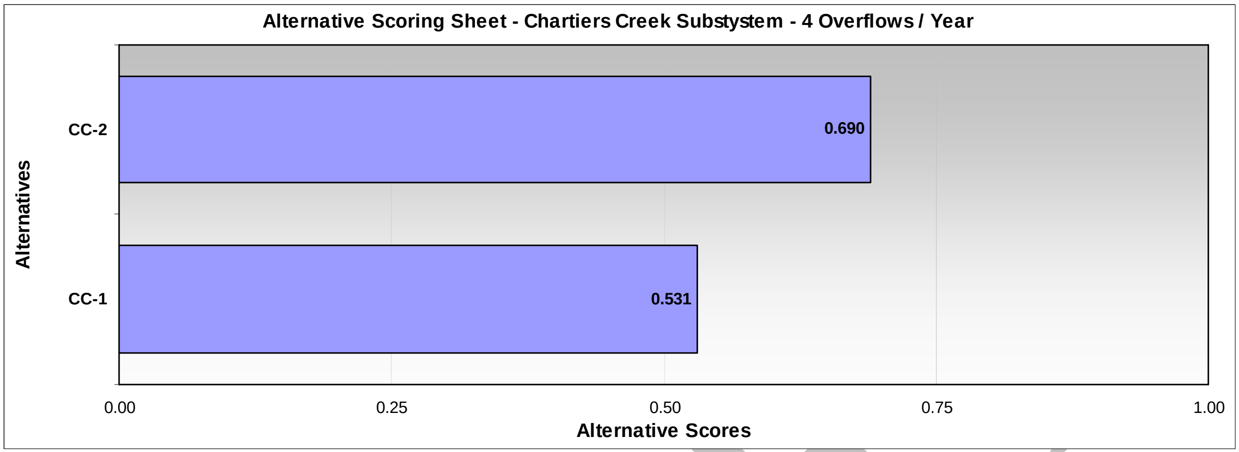
2,000 0 2,000 Feet

Attachment 6 Subsystem Alternative CC-3

CSO Controls Alternatives

PWSA THE PITTSBURGH WATER & SEWER AUTHORITY Quality Water Quality Service

Attachment 7 – Chartiers Creek Subsystem Alternatives Scoring Sheet



F.6 GLEN MAWR SUBSYSTEM

Description of Subsystem

The Glen Mawr Subsystem is located along the south bank of the Ohio River between the CSO structures O-08 and O-13. Control of CSOs within this Subsystem will be based upon Tunnel Storage. This combination serves to control CSOs originating from the following Region.

- O-08 to O-13 Region

All of these outfalls in the Region currently convey overflows from each of the respective ALCOSAN diversion chambers to the Ohio River.

The entire area that is encompassed in this alternative includes approximately 806 acres of residential, business and commercial users.

<u>Description of Alternatives</u>

In an effort to determine the most effective combination of controls for this Subsystem, one alternative was developed and evaluated: GM-1. This subsystem is based upon a capture level of 4 CSO events per year. A brief description of each is given below.

Alternative GM-1

Alternative GM-1 is based upon Tunnel GM-1 having an approximate length of 5600 feet. The overflows collected in the tunnel will be stored and pumped to the ALCOSAN interceptor for treatment at the ALCOSAN WWTP. *Attachment 1- Subsystem Alternative GM-1 Tunnel Portion* illustrates the location of the trunk sewers, outfalls, regulators, overall tributary area, and approximate location of the tunnel.

Tunnel GM-1 sees a combined maximum overflow volume during the typical year baseline conditions simulation (2005) ranges from 27.18 MG to 5.60 MG for control levels of 0 to 6 overflow events, respectively. *Figure 1 –GM-1 Tunnel CSO Volume* illustrates the peak volumes of the 21 largest CSO events during the typical year baseline conditions simulation.

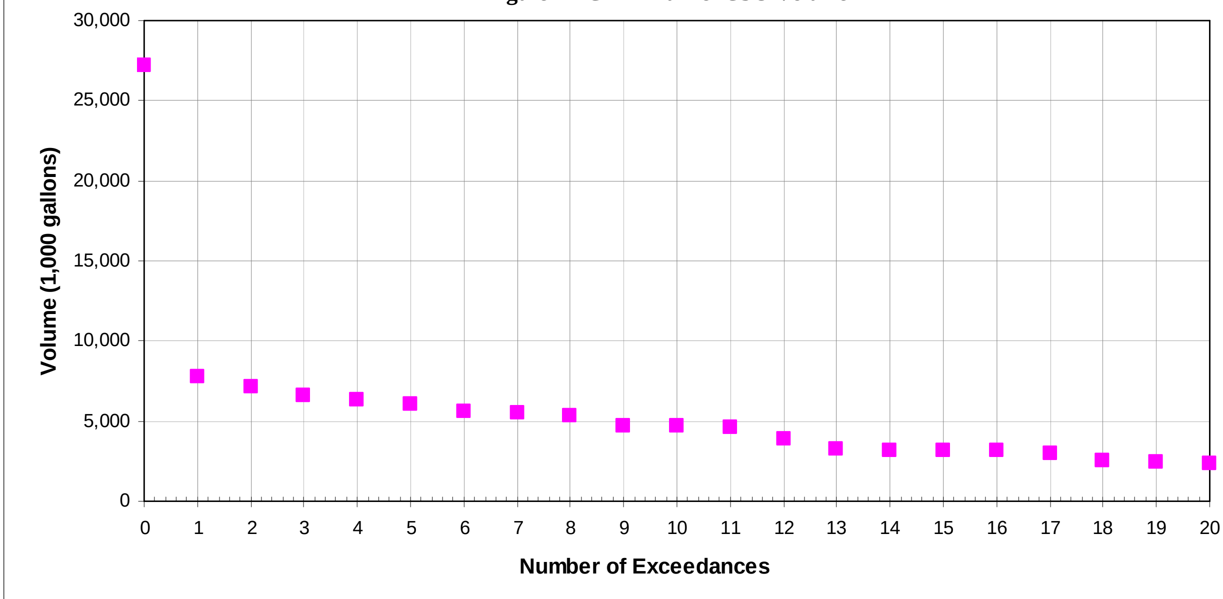


Figure 1 - GM-1 Tunnel CSO Volume

Table 1 – Alternative GM-1 Characteristics summarizes the number of overflow events experienced by each group of outfalls included in this alternative during the Typical Year Baseline Condition simulation and sewershed characteristics for this Region.

Table 1: Alternative GM-1 Characteristics

Outfall Grouping/Region	Outfall	Area (Acres)	No. of Overflow Events	CSO Control Technology
O-8 to O-13 Region	O-08	19	94	Tunnel GM-1
	O-09	15		
	O-10	7		
	O-11	52		
	O-13	713		

Tunnel GM-1

The Glen Mawr Tunnel GM-1 would be constructed along a path parallel to the ALCOSAN interceptor from ALCOSAN diversion chambers C-02 to O-13. A pump station would be required to dewater the tunnel storage volume into either the ALCOSAN interceptor (for treatment at the WWTP) or directly to a future treatment facility. The tunnel dewatering time is assumed to be one day resulting in a pump station capacity requirement of approximately 6 MGD for 4 overflows. Assuming a tunnel length of approximately 1.1 miles, the tunnel diameter required to store the volume for the 4 overflow per year control level is 15.5 feet.

Other important components of Tunnel GM-1 include drop shafts and consolidation sewers. Drop shafts would be periodically located along the tunnel to convey flow from overflow structures and consolidation sewers to the storage tunnels. Drop shafts and consolidation sewers will be sized for flow rates corresponding to a control level of 0 overflows per year to ensure that the only overflows occurring from the associated diversion structures will be a result of the tunnel design capacity rather than the consolidation pipe design capacity.

Table 2 – Tunnel GM-1 Consolidation Sewer and Drop Shaft Characteristics summarizes the flow rates and required diameters of the drop shafts and consolidation sewers at a control level of 0 overflows per year. Drop shafts receiving flows greater than 25 MGD will be vortex shafts. Shafts receiving flow less than 25 MGD will be straight drop shafts.

Table 2: Tunnel GM-1 Consolidation Sewer and Drop Shaft Characteristics

Drop Shaft Number	Location	Consolidated Outfalls	Drop Shaft Flow Rate for 0 Overflows per Year (cfs)	Consolidation Pipe Length (ft)	Consolidation Pipe Diameter for 0 Overflows per Year (in)
GM-1	Near O-08	O-08, O-09, O-10	45.69	1,285	48
GM-2	Near O-13	O-11, O-13	582.51	1,195	120

There appears to be an adequate amount of available space for potential pumping facilities and access for the TBM in the vicinity of C-02. Bordering the tunnel alignment are several areas of critical infrastructure including local and interstate highways; bridges; railroads; riverfront development; as well as natural features such as the Ohio River. Approximately 1.3 acres of land will be required to accommodate a dewatering pump station and ancillary facilities.

Attachment 2 – Subsystem Alternative GM-1, shows the areas tributary to the tunnel, CSO locations, proposed drop shaft locations, facility location (including pump dewatering pump station and odor control and screening facilities), and the location of the proposed tunnel. These locations are approximate locations.

Alternative Evaluation Results

Table 3 – Glen Mawr Subsystem Alternative Costs, illustrates the planning level capital, O&M and present worth costs associated with alternative GM-1.

Table 3: Glen Mawr Subsystem Alternative Costs

Alternative	Capital Cost (MM$)	Annual O&M Cost (MM$)	PW Cost (MM$)
GM-1	46.0	0.5	52.1

For the purpose of this Feasibility Study, the above alternatives were further evaluated based on a combination of their economic, environmental, implementation, and operational impacts over a range of CSO control levels corresponding to 4 untreated overflows per year.

The Subsystem Alternative GM-1 was the only alternative developed for the Glen Mawr sewershed. Therefore it was not scored against other alternatives for economic, environmental, implementation, an operational evaluation factors.

Recommendations

It is recommended that Alternative GM-1 be carried forward as part of the overall System-Wide alternative

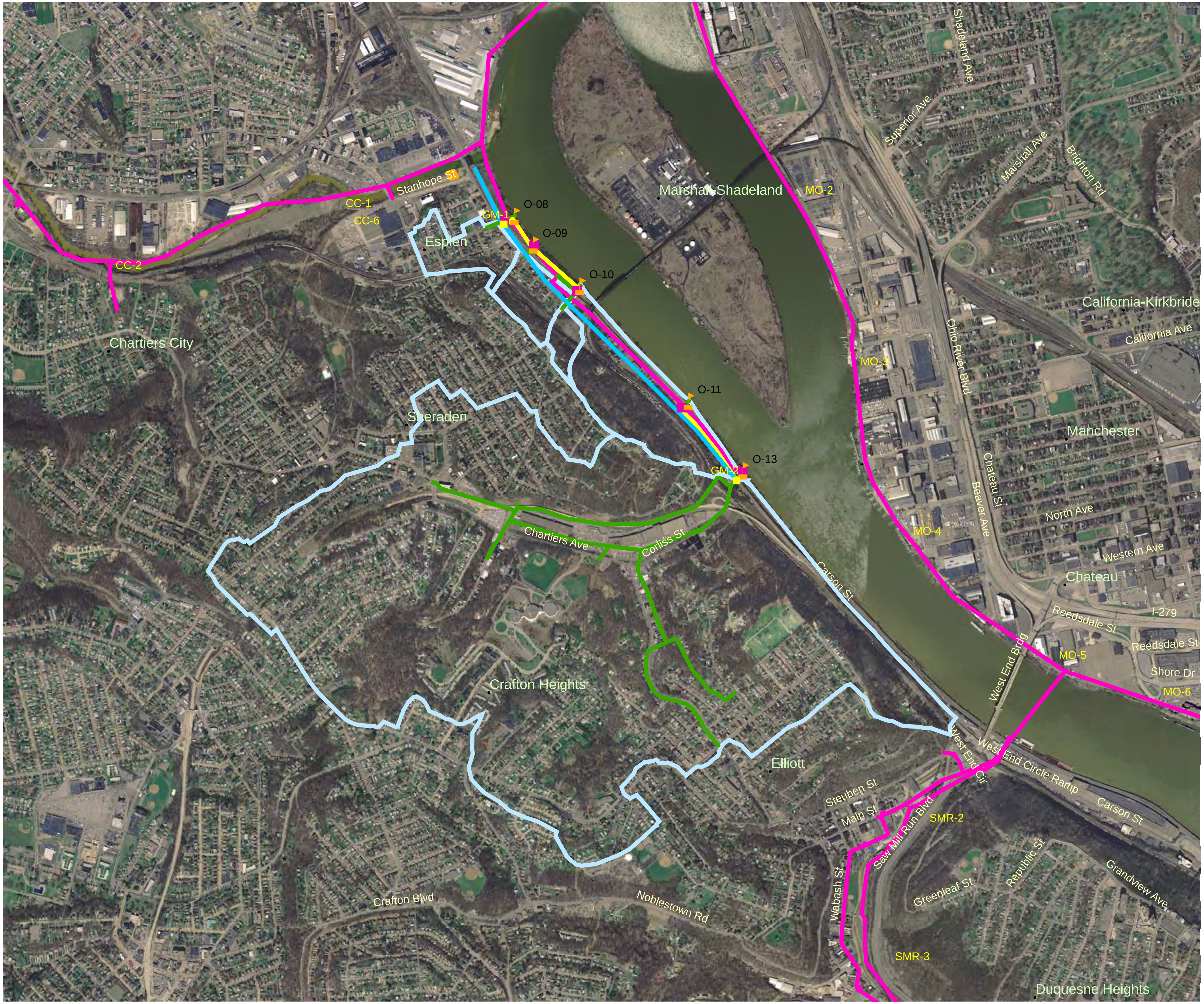
- GM-1: This alternative resulted in the highest score for control level of 4 events per year.

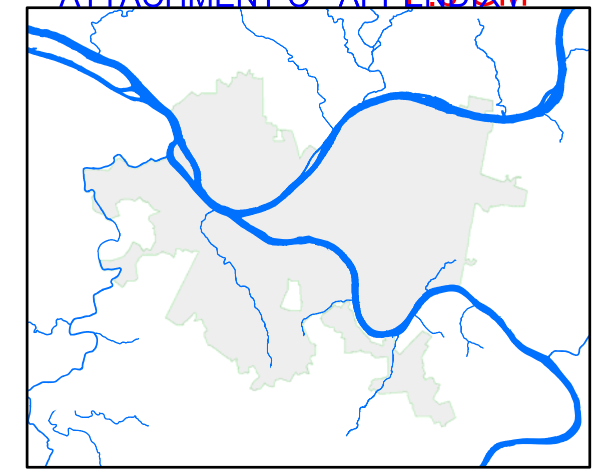
Significant Issues

Some issues exist with the siting of a tunnel. It appears that there is some space for the facilities associated with the tunnel, however, there is significant infrastructure at intermittent locations along the entire length of the tunnel alignment. Detailed geotechnical studies would have to be completed to determine the suitability of the underlying subsurface conditions for tunnel construction. In addition, construction of drop shafts and the consolidation sewers will be a significant endeavor considering the congested infrastructure and natural features that exist in the area where the sewers would be constructed. In addition to the geotechnical studies, permitting, and land acquisition would determine the final location of these facilities if this alternative is selected for implementation. Any potential issues associated with the outlier outfalls are presented in the Outfall Specific and Consolidated Outfall Analysis or the Regional Analysis appendices.

Attachment 1- Subsystem Alternative GM-1 Tunnel Portion

Attachment 2 – Subsystem Alternative GM-1





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel GM-1
- Consolidation Pipe
- ALCOSAN Interceptor
- Trunk Sewer
- ALCOSAN Diversion Structure
- Drop Shaft
- Combined Sewer Outfall

1,000 0 1,000
Feet

Attachment 1
Subsystem Alternative GM-1 Tunnel Portion

CSO Controls Alternatives

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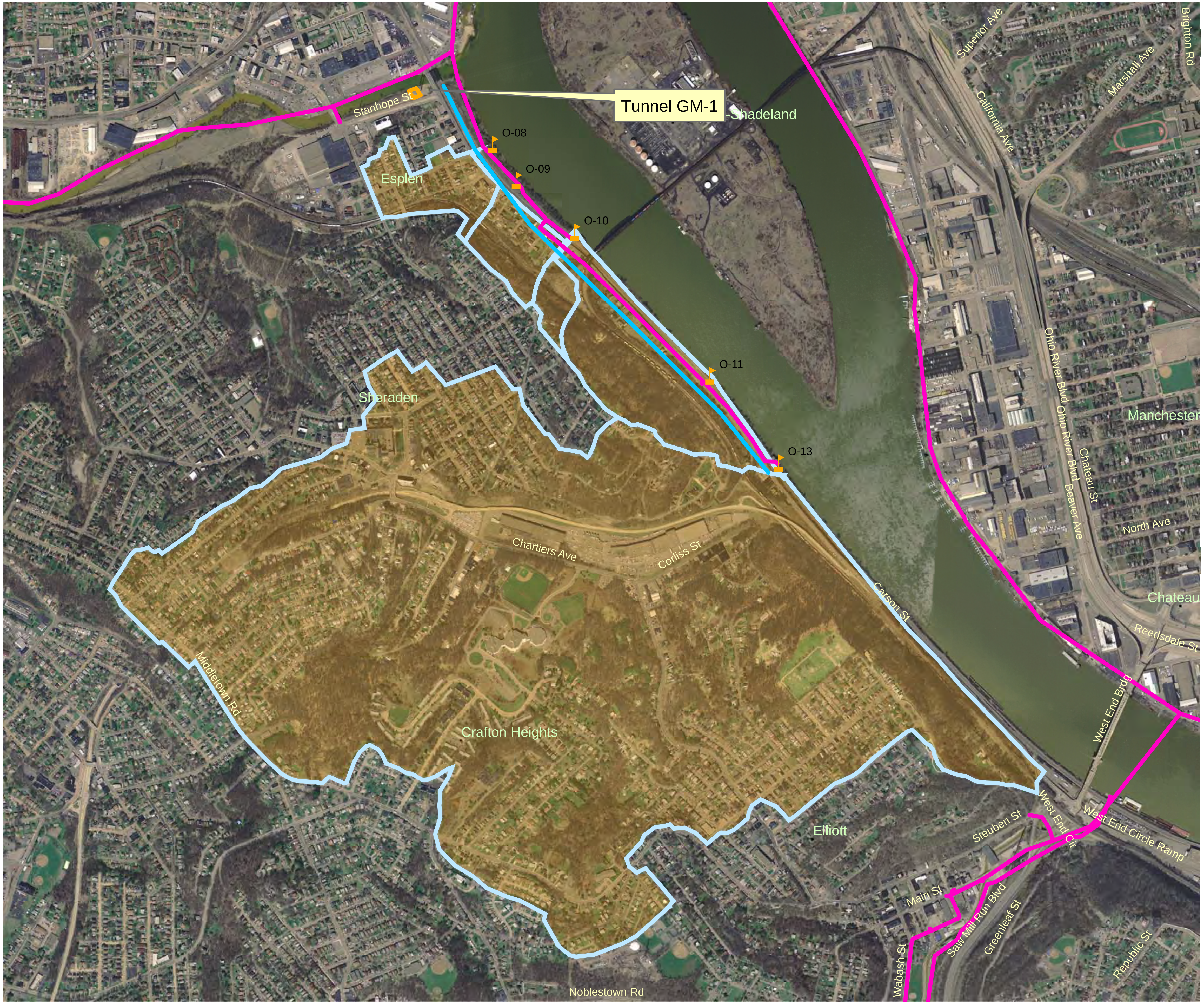
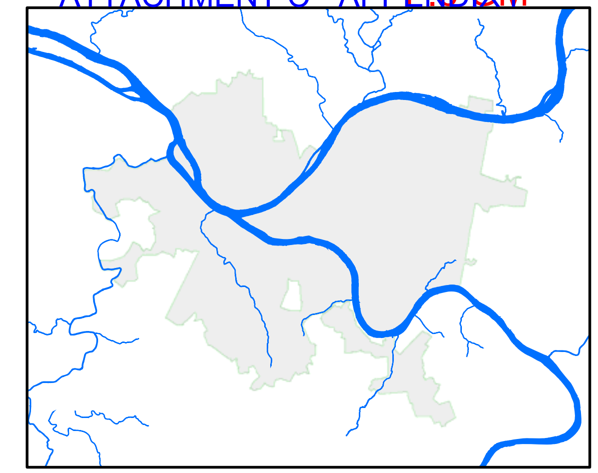
ATTACHMENT C - APPENDIX F E.6.GM





Legend

- Sewershed Boundary
- Facility Boundary
- Tunnel Storage
- Tunnel GM-1
- ALCOSAN Interceptor
- ALCOSAN Diversion Structure
- Combined Sewer Outfall

1,000 0 1,000 Feet

Attachment 2 Subsystem Alternative GM-1

CSO Controls Alternatives

PWSA
THE PITTSBURGH WATER & SEWER AUTHORITY
Quality Water Quality Service

Table G-1
Convey Overflows to ALCOSAN Interceptor (Z Agreement Alternative)

System	Consolidation Sewer Name	Connection Point to ALCOSAN Interceptor	Outfalls Included in Consolidation	Overflow Statistics for Consolidation: CSO Statistics Name	CSO Statistics Source	Control Level	Peak Flow Rate (MGD)	Peak Flow Rate (cfs)	Cost and Sizing Analysis – 1. Consolidation Sewer Parameters: Sewer Length (ft) Input by Engineer	First Quarter of Length (25% of Peak Flow Rate): Sewer Diameter (in) Based on cost spreadsheet	First Quarter: Sewer Depth (ft) Input by Engineer	First Quarter: Subtotal Cost ($)	Second Quarter of Length (50% of Peak Flow Rate): Sewer Diameter (in) Based on cost spreadsheet	Second Quarter: Sewer Depth (ft) Input by Engineer	Second Quarter: Subtotal Cost ($)	Third Quarter of Length (75% of Peak Flow Rate): Sewer Diameter (in) Based on cost spreadsheet	Third Quarter: Sewer Depth (ft) Input by Engineer	Third Quarter: Subtotal Cost ($)	Fourth Quarter of Length (100% of Peak Flow Rate): Sewer Diameter (in) Based on cost spreadsheet	Fourth Quarter: Sewer Depth (ft) Input by Engineer	Fourth Quarter: Subtotal Cost ($)	Total Construction Cost ($)
Allegheny North	CSO 163G001	NA	CSO 163G001	CSO 163G001	Outfall Specific - use Sewer Separation Costs for this outfall because it is too far from interceptor	0	12.01	18.58	-	36	20	$ -	36	20	$ -	36	20	$ -	36	20	$ -	$ -
Chartiers Creek	Bells Run	Intersection of tunnel and Bells Run collector pipe	CSO 039E001 CSO 039J001 CSO 068H001 CSO 068H002 CSO 039K001	Bells Run	Regional	0	126.99	196.48	9,885	48	20	$ 2,069,000	66	20	$ 3,096,000	78	20	$ 3,943,000	90	20	$ 4,920,000	$ 14,028,000
Sawmill Run	S-18 to CSO 095J001	Near CSO 095J001	S-18, CSO 095E001, CSO 095J001,	S-18 to CSO 095J001	Regional	0	16.75	25.92	8,875	36	20	$ 1,388,000	36	20	$ 1,388,000	36	20	$ 1,388,000	48	20	$ 1,858,000	$ 6,022,000
Sawmill Run	CSO 060A001	at interceptor	CSO 060A001	CSO 060A001	Outfall Specific	0	34.72	53.72	1,557	36	20	$ 244,000	48	20	$ 326,000	48	20	$ 326,000	66	20	$ 488,000	$ 1,384,000
Sawmill Run	S-40 and 016A001 to 036R001	Near ACSO 005F001	ACSO 005F001 (S-40), CSO 016A001, CSO 016A002, CSO 035A001, CSO 035E001, CSO 035J001, CSO 036R001	S-40 and 016A001 to 036R001	System Wide Additional Consolid	0	129.2226	199.94	14,960	48	20	$ 3,131,000	66	20	$ 4,686,000	78	20	$ 5,968,000	90	20	$ 7,446,000	$ 21,231,000
Sawmill Run	CSO 019M001	Near CSO 019M001	CSO 019M001	McCartney - DCs	Outfall Specific (may need special key table)	0	98.59	152.54	5,355	48	20	$ 1,121,000	66	20	$ 1,677,000	78	20	$ 2,136,000	90	20	$ 2,665,000	$ 7,599,000
Sawmill Run	McDonoughs	Near McDonoughs Run intersection with interceptor	CSO 097L001, CSO 139A001, CSO 139B001, CSO 139B002, CSO 139B003	McDonoughs	Regional	0	133.72	206.89	7,095	66	20	$ 2,222,000	78	20	$ 2,830,000	90	20	$ 3,531,000	96	20	$ 3,917,000	$ 12,500,000
Sawmill Run	CSO 015P001	Near CSO 015P001	CSO 015P001	CSO 015P0001	Outfall Specific	0	292.97	453.29	11,465	78	20	$ 4,574,000	96	20	$ 6,329,000	120	20	$ 9,196,000	120	20	$ 9,196,000	$ 29,295,000
Sawmill Run	CSO 034R001	at interceptor	CSO 034R001	CSO 034R001	Outfall Specific	0	1.29	2.00	698	36	20	$ 109,000	36	20	$ 109,000	36	20	$ 109,000	36	20	$ 109,000	$ 436,000
Sawmill Run	CSO 138J001 and CSO 138P001	at interceptor	CSO 138J001, CSO 138P001	CSO 138J001	Outfall Specific	0	1.90	2.94	2,953	36	20	$ 462,000	36	20	$ 462,000	36	20	$ 462,000	36	20	$ 462,000	$ 1,848,000
Mon-Ohio	Nine Mile Run	at interceptor			Regional	0	89.50	138.48	16,800	48	20	$ 3,516,000	66	20	$ 5,262,000	78	20	$ 6,702,000	78	20	$ 6,702,000	$ 22,182,000
Mon-Ohio	CSO 030N001	at interceptor	CSO 030N001	CSO 030N001	Outfall Specific	0	1.43	2.21	5,654	36	20	$ 884,000	36	20	$ 884,000	36	20	$ 884,000	36	20	$ 884,000	$ 3,536,000
Mon-Ohio	CSO 032N001	at interceptor	CSO 032N001	CSO 032N001	Outfall Specific	0	1.99	3.08	7,835	36	20	$ 1,225,000	36	20	$ 1,225,000	36	20	$ 1,225,000	36	20	$ 1,225,000	$ 4,900,000
Mon-Ohio	Streets Run	at M-42	CSO 184E001 CSO 185H001 CSO 134A001 ACSO M-42	Streets Run	Regional	0	45.42	70.27	11,755	36	20	$ 1,839,000	48	20	$ 2,460,000	66	20	$ 3,682,000	66	20	$ 3,682,000	$ 11,663,000

Table G-1
Convey Overflows to ALCOSAN Interceptor (Z Agreement Alternative)

Consolidation Sewer Name	2. Interceptor Connection Parameters									3. Land Acquisition Parameters			4. Regulator Parameters			6. Total Construction Cost
	8"-24" Connections		25"-48" Connections		49"-72" Connections		>73" Connections									
	Total Number of 8"-24" Connx Input by Engineer	Subtotal Cost ($)	Total Number of 25"-48" Connx Input by Engineer	Subtotal Cost ($)	Total Number of 49"-72" Connx Input by Engineer	Subtotal Cost ($)	Total Number of >73" Connx Input by Engineer	Subtotal Cost ($)	Total Construction Cost ($)	Land Acquisition - Consolidation Sewers (SF) Input by Engineer	Land Required Cost ($ / SF)	Land Acquisition Cost ($)	Regulator Construction (0=None; 1=New Static; 2=New Auto; 3=New Reg/Existing Structure; 4=Mod Reg)	Number of Regulators	Construction Cost ($)	Total Construction Cost ($)
CSO 163G001	-	$ -	-	$ -	-	$ -	-	$ -	$ -	-	$ 2	$ -	1	1	$ 642,000	$ 3,207,000
Bells Run	-	$ -	-	$ -	-	$ -	1	$ 171,000	$ 171,000	494,250	$ 2	$ 989,000	1	9	$ 5,778,000	$ 20,966,000
S-18 to CSO 095J001	-	$ -	1	$ 115,000	-	$ -	-	$ -	$ 115,000	443,750	$ 2	$ 888,000	1	7	$ 4,494,000	$ 11,519,000
CSO 060A001	-	$ -		$ -	1	$ 137,000		$ -	$ 137,000	77,850	$ 2	$ 156,000	1	1	$ 642,000	$ 2,319,000
S-40 and 016A001 to 036R001	-	$ -	-	$ -	-	$ -	1	$ 171,000	$ 171,000	748,000	$ 2	$ 1,496,000	1	11	$ 7,062,000	$ 29,960,000
CSO 019M001	-	$ -	-	$ -	-	$ -	1	$ 171,000	$ 171,000	267,750	$ 2	$ 536,000	1	7	$ 4,494,000	$ 12,800,000
McDonoughs	-	$ -	-	$ -	-	$ -	1	$ 171,000	$ 171,000	354,750	$ 2	$ 710,000	1	6	$ 3,852,000	$ 17,233,000
CSO 015P001	-	$ -	-	$ -	-	$ -	1	$ 171,000	$ 171,000	573,250	$ 2	$ 1,147,000	1	11	$ 7,062,000	$ 37,675,000
CSO 034R001	-	$ -	1	$ 115,000		$ -		$ -	$ 115,000	34,900	$ 2	$ 70,000	1	1	$ 642,000	$ 1,263,000
CSO 138J001 and CSO 138P001	-	$ -	1	$ 115,000	-	$ -		$ -	$ 115,000	147,650	$ 2	$ 295,000	1	2	$ 1,284,000	$ 3,542,000
Nine Mile Run	-	$ -		$ -		$ -	-	$ -	$ -	840,000	$ 2	$ 1,680,000	1	11	$ 7,062,000	$ 30,924,000
CSO 030N001	-	$ -	1	$ 115,000		$ -		$ -	$ 115,000	282,700	$ 2	$ 565,000	1	1	$ 642,000	$ 4,858,000
CSO 032N001	-	$ -	1	$ 115,000		$ -		$ -	$ 115,000	391,750	$ 2	$ 784,000	1	1	$ 642,000	$ 6,441,000
Streets Run	-	$ -		$ -	1	$ 137,000		$ -	$ 137,000	587,750	$ 2	$ 1,176,000	1	4	$ 2,568,000	$ 15,544,000
																$ 174,078,000